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The MONTHLY REVIEW

Published by the AMERICAN ELECTRO-PLATERS' SOCIETY

A Society
for the Advancement of the Science of
Electro-Plating

MAY 1936 · IN THIS ISSUE

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IN THE SPOTLIGHT

Since the start of electroplating, Hanson-Van Winkle-Munning Company has been outstanding as an organization devoted to the advancement and improvement of the industry.

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The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

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VOL. XXIII MAY 1936 NO. 5

Every Member of the A. E. S. Should Attend the Annual Meeting and Convention

This year our Convention is being held in Cleveland, a city of which volumes could be written, but there is nothing like seeing a place yourself, and there are more reasons than this why you should be there.

We realize that the real reason for our Annual Convention is and always will be business and education, also, to legislate laws for every branch and member of the A.E.S. Therefore, the permanency of our Society depends greatly on the attendance and support which our Annual Convention receives. In reality these gatherings are the pulse of the organization. I am sure that those members of the A.E.S. who have at heart the future of the art of electroplating are desirous of doing everything possible to advance the calling which provides their livelihood. See that your branch realizes that it is its solemn duty to send a delegate or the full quota of delegates to the Annual Meeting. Having a large representation permits the exchange of a variety of ideas, and more influence is exerted where large gatherings of men assemble for serious and constructive work.

It is at these meetings that the actions of your Supreme Officers and their interpretation of your laws during the past year are on trial. In truth our Annual Meeting is the most serious and by far the outstanding activity scheduled by the A.E.S. It is there that suggestions emanating from the delegates assembled or submitted by our branches, in the form of resolutions or amendments to our Constitution must be discussed, discarded or accepted as the delegates elect. This year some important amendments are being sponsored by the Baltimore-Washington Branch, and our Editor

will have some constructive ideas to advance relative to the future policy of the MONTHLY REVIEW. A program or plan on the future problem for research must be considered. Friendships of life-long standing are frequently started at our Annual Conventions, because there we meet platers, chemists and engineers who "speak our language" many of whom have encountered experience and difficulties in electroplating similar to our own, and who will gladly share their knowledge.

And last but most important, we must elect our leaders for the coming year. This reponsibility cannot be taken lightly, and the delegates should consider thoughtfully and tirelessly because the destiny and very life of our Society depends on your Supreme Officers. Every member of the A.E.S. should promote his term of association with our organization, so that his familiarity with its ideals, hopes and resources prepares him to step into the office of the presidency when so honored by the call. The duties of the office are educational, thrilling, and a distinction every member should desire.

To those members who have served on committees either in our branches or for the Supreme Society, and for the efforts of individual members, I extend my personal good wishes and thanks for the genuine cooperation received during my term of office.

T. F. SLATTERY, *President.*

To the Chairmen of Branch Exhibits for Cleveland Convention,
Greetings:

Again we call your attention to the time remaining in which the Branches and individual members will be able to prepare and make space reservation for that Exhibit. Your committee has provided what appears to be adequate space to accommodate this part of the Exposition. If you have any intention of bringing or sending such a show to Cleveland, please let the undersigned know at once that we can reserve extra space if needed. When we receive notice of your intentions, we will forward instructions as to forwarding of your exhibit, that it may arrive with minimum handling at the Exhibit quarters.

Please address all communications relative to this matter to—

MR. J. C. SINGLER,
3379 West 95th Street,
Cleveland, Ohio

LIST OF THE PAPERS TO BE DELIVERED AT THE CONVENTION

1. **Some Factors covering the ductility of Nickel Electrodeposits.** MR. E. A. ANDERSON, Chief Metal Section, Research Division, New Jersey Zinc Co., Palmerton, Penna.

2. **Calcium Chloride Corrosion of plated Automotive Parts can, and should be reduced.** DR. E. M. BAKER and HOWARD R. WILSON, University of Michigan.

3. **Summary of Researches on Electrodeposition at the National Bureau of Standards.** DR. WILLIAM BLUM, Bureau of Standards, Washington, D. C.

4. **Making and Operating of Rhodium Solutions.** MR. LIONEL CINAMON, Member of New York Branch.

5. **Brass Plating for Rubber Adhesion.** DR. HARRY P. COATS, Firestone Steel Products, Akron, Ohio.

6. **The Electrodeposition of Nickel on Zinc.** MR. J. M. COSGROVE, Noblitt-Sparks Industries.

7. **Buffer Action of Certain Chemicals in Relation to pH Control of Nickel Solutions.** DR. D. A. COTTON, Delco-Remy Corporation, Anderson, Indiana.

8. **Process Control and Finishing Costs.** MR. H. L. FARBER, Chief Chemist, Westinghouse Electric and Manufacturing Co., Mansfield, Ohio.

9. **Electrodeposition of Zinc and its Protective Value.** MR. GEORGE B. HOGABOOM, Hanson-Van Winkle-Munning Co.

10. **The Present Status of Electrodeposits of Tungsten from Aqueous Plating Baths.** MR. M. L. HOLT, Instructor in Chemistry, University of Wisconsin.

11. **Films and Their Relation to Cleaning before Electroplating.** C. Johnson, Technical Director, Oakite Products, Inc.

12. **The Rapid Electrodeposition of Iron.** DR. C. KASPAR, U. S. Bureau of Standards, Washington, D. C.

13. **The Properties of Fused Alumina Grain for Polishing.** Mr. A.A. KLEIN, The Norton Company, Worcester, Mass.

14. **Results of the Electroplating Research at Indiana University including Plating of Tin, Aluminum, Bismuth, Antimony, Tellurium, Silver, Gold, Lead and Nickel.** Dr. F. C. MATHERS, Indiana University.

15. **The Orientive Effects of the Geometrical and Crystalline Structure of the Basis Cathode on the Crystal Structure of Electrodeposits.** Mr. WALTER R. MEYER, General Electric Company.

16. **Resume of Research Committee's Work during the Past Year.** Mr. WM. M. PHILLIPS, Chairman of Research Committee.

17. **Polishing Grain and its Application.** Mr. H. R. POWER C. E. Carborundum Company.

18. **Comparative Evaluation of Modern Finishes.** MR. ROON, Roxalin Flexible Lacquer Co.

19. **Stability of Plating Solutions.** DR. G. SODERBERG, The Udylite Company.

20. **Effect of Composition and Structure on Corrosion of Nickel Anodes.** Mr. A. G. SPENCER, Chevrolet Motor Car Company.

21. Experience in the Plating of Non-Ferrous Metals for Exposure Tests. MR. P. W. C. STRAUSSER, U. S. Bureau of Standards, Washington, D. C.

22. A Paper to be read by Dr. M. R. Thompson, U. S. Bureau of Standards. Subject to be announced later.

23. The Effect of Nickel Chloride in Nickel Plating Solutions. MR. M. WAITE, Director of Research, McGean Chemical Co.

24. Metal Rectifiers. DR. R. M. WICK, United States Navy Yard.

25. The Commercial and Practical Aspects of Throwing Power as a Factor in the Character of Deposits. MR. DONALD WOOD, Reed and Barton Co., President Boston Branch.

26. Aluminum Reflectors. DR. H. K. WORK, Aluminum Company of America.

The order in which these papers are listed does not govern the sequence in which they are to be delivered, since the arrangement has been prepared according to the alphabetical position of the authors' names.

One has but to look over the well balanced variety of the subjects to be discussed, and the galaxy of authorities who are presenting them, to remove from one's mind any doubt as to whether you should attend this Convention. Instead the uppermost thought will be how can you afford to stay away and miss the opportunity of discussing first hand that vexing problem which has arisen sometime during the past few months.

Business is well on the uptrend now. Will your present methods and equipment be equal to the increased production you will be called upon to get out? The answer to this will be found in Cleveland, where you will be able to see the latest finishing and plating equipment developments, a greater portion of which will be in actual operation.

This great combination of oral and visual pabulum will be offered for your mental improvement all under one roof. From the time you arise in the morning until close of day you will be able to leave your coats and hats in your room, leaving both hands free to make use of that pencil and note book which we hope you have not forgotten to bring along.

We do not expect you to be able to remember all the formulae you may obtain nor the particular graphs used in the illustration of some very important paper. It has been the custom each year to publish a verbatim report of the Convention. Copies of this Report have been prepared in quantity sufficient to supply the subscription list obtained at the Convention. There will be available at the Registration desk cards for this purpose. Please do not neglect to order a copy of this report as soon as you register, since you may not remember to do so owing to the many events which will take up your attention. Altho we ran additional copies of the Report for the Bridgeport Convention they

have been long sold out and many members disappointed in not obtaining a copy especially after they had an opportunity to see what a fine job the Reporting Company had made of it. This of course was improved thru the assistance of the Bridgeport Branch on cuts, etc. We can assure you this year's issue will be its equal since the same concern has been engaged to cover the Convention and later publish the report.

Very soon now each member will receive a copy of the official program which will contain a program of all the events that have been arranged both for our gentleman and lady guests. We feel that we cannot sign off until we have confirmed the previous statements made in past issues as to what the ladies will do and see while in Cleveland. Bring the wife along since we can assure you that our ladies committee will make her feel at home while you are with us, leaving you free to attend the sessions without a thing on your mind to detract from this unparelled opportunity to bring your methods up to date, renew those old acquaintances, and return with the will to lick every problem that comes up with new weapons.

RAILROAD TARIFF

The space is too limited here to give you complete instructions relative to the arrangements for reduced rates. We are preparing a folder to accompany the program you will receive soon. Study it, and be prepared with that certificate when you arrive in Cleveland.

It is to be hoped that those residing near Cleveland will be of assistance in obtaining this rate, especially for the long distance travellers, since your certificate will count as much as a member coming from California.

We have been advised that the red tape to be unravelled before the ICC tariff reduction is effective will delay the application of the new rates to Cleveland. As it has been pointed out this rate is only applicable to coach fares, and that the average cost of mileage under the certificate plan will closely approximate this rate with the added advantage of first class passage particularly in night travel. BE SURE TO READ CAREFULLY THE LEAFLET ON TRANSPORTATION YOU WILL FIND IN YOUR PROGRAM.

PERMANENT CHARTERS GRANTED

The Executive Committee of the Supreme Society has granted Permanent Charters to the Binghamton-Elmira N. Y. and Springfield, Mass. Branches of the A. E. S. Both of these Branches made their requests to the Supreme Secretary several weeks ago.

Relative Value of Accelerated Corrosion *and Outdoor* Exposure Tests

By WILLIAM BLUM

THIS subject of the relative value of accelerated tests has come up during the past few years in every meeting of the Committee on Specifications, and will be referred to, to some extent by omission, in the report that will be discussed this afternoon on the standards and specifications for plating. It is, therefore, appropriate to discuss briefly the factors that should be considered in connection with these accelerated tests. I will not go into detail nor give any data. Instead, I will refer you to N. B. S. Research Paper 724 for the effects of accelerated tests on the specimens of steel plated with nickel and chromium.

Perhaps the exact title of this paper should be "The Relation of Accelerated Tests to the Actual Service or Value of the Coating." The question of the value of the coating involves a definition of plating. I will read a definition of electroplating (just in case any of you may not know what electroplating is!) This is the definition from the American Standards Definitions of Electrical Terms: "Electroplating is the electrodeposition of an adherent coating upon an electrode for the purpose of securing a surface with properties or dimensions different from those of the base metal". That definition is broad enough to include any kind of a coating that is put on adherently for the purpose of changing the properties or dimensions of the surface.

We are concerned chiefly in this discussion with the protection against corrosion that is afforded by a plated coating. We have to consider two types of coating, for which different tests must be used. We call "noble" coatings those in which the metal coating is less readily corroded than the base metal; and "basic" coatings, those in which the coating is more readily corroded than the base metal.

Two examples of the latter class are zinc and cadmium, and

with respect to steel all other coatings fall in the first class, that is, noble coatings. All of the tests have shown that the value of a noble coating depends mostly on its porosity, while the value of a basic coating depends mostly on its minimum thickness. If we keep these requirements in mind, we can decide upon the factors that should be included in accelerated tests.

Outdoor exposure tests, valuable as they are, are not a complete answer to the problem of protective coatings. The tests that we have made and the tests that we expect to make give us useful information, but they do not tell the whole story. For one thing, strange as it sounds, there are more than six kinds of climate in the United States! Just putting specimens up at six places does not necessarily tell us what is going to happen under any other combination of conditions. In the second place, in making these tests we have to keep them as simple as possible and, therefore, we deliberately omit many of the factors which enter into the life of a coating in service. For example, on an automobile the plated parts are at least occasionally washed, and at the same time are very likely to be wiped with rags which have wax or grease on them. There is no doubt that the plating on automobile parts lasts longer, on the average, than it would last if it were left outdoors continuously in the atmosphere, as is done in the exposure tests as now carried on. So the outdoor exposure tests give only relative values, and then only for comparable climates.

The purpose of an accelerated test, as its name implies, is to determine in a short time the *relative* value of *similar* coatings. I want to emphasize that. Most of the persons who use these tests have now come to the conclusion that an accelerated test is of value only for determining the relative protective value of similar coatings, and not of entirely dissimilar coatings.

The question as to whether there is a need for accelerated tests comes up very frequently. The need for such tests has somewhat decreased during recent years as the result of the development of better tests for the porosity of noble coatings, such as the ferroxyl test, which is used on nickel, copper and chromium coatings, and of methods like the dropping test for determining the local thickness of a basic coating, such as of zinc or cadmium. At first

it might even appear that there is no need for accelerated tests, and actually the specifications referred to place relatively little weight on such tests.

I believe, however, that accelerated tests are useful, not only for research purposes, but also for testing. The two principal factors that were referred to, porosity and thickness, are not the only factors in the life and protective value of a coating. For example, we may have two noble coatings of equal porosity, but under one or another condition of service the pores in the one might be more readily filled by the products of corrosion than those in the other.

Consequently, we might have more extensive corrosion with the latter coatings than with the former, even though they had the same degree of porosity. Similarly with the basic coatings of zinc and cadmium, some conditions of exposure might be more likely to produce an adherent film, such as Dr. Burns referred to last evening, on one than another coating, which would affect the rates at which they would dissolve in the atmosphere. Consequently, it is valuable to have accelerated tests which will at least give an indication of the behavior of the coatings under conditions, which if not actual service conditions, at least more nearly approach them than the mere testing of porosity or of thickness. In using an accelerated test, we should keep in mind whether it does introduce those secondary factors which may have some effect on the life of the coatings.

I have listed here, in what I believe is the order of their importance, four requirements of a satisfactory accelerated test: First, it should be significant; second, it should be rapid; third, it should be reproducible; and fourth, it should be inexpensive.

I will illustrate these requirements by means of the salt spray test, not because I consider it an entirely satisfactory test, but because it is the one that has been the most used and the one with which you are most familiar.

First, the test must be significant. There is no use of applying in accelerated tests reagents or conditions which have no relation whatever to the conditions to which the material is likely to be subjected in service. For example, whether one of two coatings is

dissolved or attacked more readily than the other in dilute hydrochloric acid, or in acetic acid, has no necessary bearing on what they will do in the atmosphere. The salt spray test finds its justification in the assumption that many parts are subjected to a marine atmosphere in service, and that the salt spray contains, as an accelerating agent, a material (sodium chloride) which is present in certain types of exposure.

By the same token, we must not assume that the results in a salt spray test will necessarily be parallel to those in an industrial atmosphere. We have ample evidence in the case of zinc and cadmium coatings that the results in the salt spray test are not parallel to those in industrial atmospheres. Even though the results of the exposure tests on zinc and cadmium are not yet prepared for publication, we are justified in saying that in industrial atmospheres cadmium coatings furnish less protection, that is, for a shorter time, than do zinc coatings of the same thickness, although in the salt spray test cadmium lasts a great deal longer than zinc.

The question of speed is important because it is not an accelerated test if it takes six months or a year to carry out. The salt spray test ordinarily gives the information, at least such information as can be obtained, inside of a week, and possibly in twenty-four or forty-eight hours. If that were minutes instead of hours, the test would be just that much more useful. That is one argument in favor of a simple porosity test like the ferroxyl test of noble coatings, that it takes only a few minutes. If we are to use a test for inspection purposes, that test must be rapid enough for acceptance of deliveries.

Going into a slightly different field, in the application of the salt spray test to anodic oxide coatings on aluminum, the common practice is to subject specimens to the salt spray test for thirty days and then to make a tensile strength test to measure the extent of failure in the salt spray. A thirty-day test, even though in that particular case it is apparently as good as anything that has been found up to this time, is certainly not a satisfactory accelerated test.

The question of reproducibility is important, because unless you can get results that are at least as reproducible as the specimens, such results are subject to uncertainty. Reproducibility of results implies control of conditions. There are many factors in the salt spray test that may affect the results, such as the concentration of the sodium chloride solution, the pH of the solution (although that is not so likely to vary with reasonable care), the rate of spraying, the size of the drops, the amount of air that passes, and the temperature of the box during the test. All of these must be controlled to some extent if we are to have reproducibility of results.

I have strongly urged the control of temperature in the salt spray test, because otherwise the variation from winter to summer may produce very large changes in the results with similar specimens. But I must admit that this very control of conditions is a disadvantage, in the sense that it may make the results less parallel to those obtained in service.

When plated articles are put outside under any conditions of service, the failure is at least partly related to the very changes that take place in the temperature, the humidity, and the concentration of corrosive agents. All those things may have more to do with whether the coatings fail in service than the average conditions we attempt to maintain in the salt spray test. So we are between the devil and the deep sea. If we do not have our conditions controlled, our results are not reproducible. If we do have the conditions controlled, we may have reproducible results that are less significant than they would be if the conditions were variable. If, however, we attempt to vary the conditions in a cycle, as is done in some tests, then we make the test so complicated that the chances of one person being able to reproduce the results of another are comparatively small.

The fourth item, which I have put last because I think it is least important, is the question of expense. Of course, a test should not be so expensive that it costs more to carry out than what the article is worth. On the other hand, we can never get something for nothing. If we are to improve the quality of plated coatings, we must be willing to spend money in checking the

quality, both during the process of plating and during the subsequent testing, especially of deliveries.

The experience of the automobile industry in this country has shown conclusively that a relatively large expense may be justified for testing if by it the quality and especially the uniformity of the products can be improved. The automobile industry is not so much concerned with the average quality of its products as with their uniformity. If, for example, the average was very high but ten per cent of the plating was decidedly poor, the "cusses" that they would get on account of that ten per cent of poor plating would more than nullify all the praise that they would get from the good plating on the other ninety per cent. If we are to get a uniform high quality we must be willing to pay for it.

The salt spray test, even with temperature control, is not an extravagantly expensive test. It can be installed and carried out with moderate expense. If small units in the plating industry cannot afford to put in the test for themselves, they must unite either directly or indirectly, for example through consulting laboratories, in order to have the tests made.

This is merely an outline of the factors. I have spoken of the salt spray test simply by way of illustration. The same remarks could be applied with modification to any other test that is proposed. The salt spray test is not ideal. I am not recommending it where other procedures can be used. On the other hand, I believe when all is said and done, with intelligent control of conditions and intelligent interpretation of the results, the salt spray test is probably as useful a test as any single one that we have now to determine the relative value of plated coatings.

Thank you. (Applause)

DISCUSSION

CHAIRMAN SLATTERY: Does anybody wish to ask Dr. Blum some questions? I think that as a Society we are very grateful to Mr. Strausser, our research associate, and Dr. Blum, under whose direction this corrosion testing has been carried on. I thank Dr. Blum for coming here to relate this information to us.

MR. HOGABOOM: I think we ought to have some discussion on what the general thought is regarding the value of salt spray

tests. There seems to be quite a diversity of opinion. We have some representative men here, and I think they should be asked to give their experience.

MR. STRAUSSER: For the information of those who have not received copies of the Research Papers 712 and 724, I wonder whether you would not at this time tell these people how to obtain copies.

DR. BLUM: The two Research Papers, 712 and 724, may be obtained by writing to the Superintendent of Documents at Washington, D. C.; the price is five cents each. I believe that the Secretary of the Society has a few hundred copies of each available, so that any member who did not get a copy can probably do so by writing to the Secretary.

DELEGATE: PROCTOR: Regarding the salt spray test, I think that test has been talked of about a hundred times. I think we are all familiar with the salt spray test. It was originally started in Detroit, when they started to plate rims to get a uniform coating. I do not think we can learn anything more if we discuss that subject for two hours. I think the time is more valuable to us.

MR. HOGABOOM: I did not speak about discussion of the salt spray test as a process, but of its value. There is distinct difference of opinion in every society, in the American Society of Testing Materials, in this Society, among manufacturers, and in general, as to applying the salt spray test to every kind of metal. It was developed primarily for zinc. Now is it correct to apply it for all kinds of metal under all conditions? Is that correct? There is a diversified opinion, and it is difficult to obtain consistent results. Shouldn't this Society go on record as to the advisability of seeing if something better cannot be developed? That is just exactly in line with the committee of the A.S.T.M., and surely the platers should be as much interested in that as they.

DR. HEUSSNER: I just wanted to say something about what Dr. Blum has said about the salt spray, and that is the intelligent interpretation of the results. If we all knew, or if some of us knew, how to intelligently interpret the salt spray test, it would probably give us the information we are after, but constantly you

go into some place and they tell you they are plating brass and testing it in the salt spray for eight hours, or that they are using it on sheet copper as a test, or that they are using it on steel. They are trying to apply one simple test in the same manner for the same length of time, trying to look for the same endpoint on all the things. If you could give us, or work out at some future time, the actual endpoint, and, as Dr. Blum said, the intelligent interpretation of that test, it would probably answer the purpose as well as any one single test. It will still be doubtful whether one single test, whether it be a corrosive test or any other type, chemical or microscopic or metallurgical or anything else, will give us the ultimate results we are after, and we will probably require a combination of several. But, personally, I am still very much in favor of retaining the salt spray test. More work should be done upon the salt spray test to obtain its true interpretation.

DR. BLUM: I might say very briefly that we are in entire accord on that. I delit erately confined the illustrations to plated coatings on steel because those are the only ones with which we have first-hand information, but our new program includes the study of salt spray and other accelerated tests and their application to non-ferrous metals, and the interpretation of the results to which Mr. Heussner has referred.

I might repeat very briefly what we believe is of value: That in the salt spray test as applied to noble coatings on steel, it is much more important to note the nature and number and extent of the rust spots at the end of a certain period than it is to simply say that a rust spot appeared in so many hours. That was the principal conclusion of this Research Paper 724.

So far as zinc and cadmium coatings are concerned (the basic coatings), we found that the failure in the salt spray test is approximately proportional to the thickness. The failure in an industrial atmosphere is also approximately proportional to the thickness. In that sense, therefore, the salt spray test is useful as a measure of the thickness or distribution of the coatings; but, as I indicated, the dropping test is so much quicker that if the salt spray test gives only the thickness of zinc and cadmium, its use would not be justified. Such use must be justified by getting

the effects of surface films that may be formed during the salt spray test or in service.

CHAIRMAN SLATTERY: If there are no more questions, we shall continue.

DELEGATE HANLON: While Dr. Blum was speaking he stated there were six kinds of climate in the United States.

DR. BLUM: I said more than six kinds.

DELEGATE HANLON: We could divide our Branches into regions, could we not, and obtain some special, specifically appointed agent in each one of those divisions to make accelerated tests of the two or three different methods that you had in mind and forward those comparisons to you? In that way we could add some value to the investigation relative to salt spray tests and other dropping tests, and so forth.

DR. BLUM: I think that perhaps the statement I made was not entirely clear. I referred to the fact that outdoor exposure tests must be interpreted with caution because of the great variety of climate. I think that if you have in mind the conduct of outdoor exposure tests in a greater number and variety of locations, the idea is good. But at the same time, with full appreciation of the cooperation we could get from platers in different localities, the necessity of having all the results and observations tied together involves so much more travel that it was felt better to stick to a limited number, such as six locations, rather than to have perhaps twenty-five locations and not be able to make the observations as uniformly as would be possible in a smaller number. Of course, an accelerated test is just the same whether it is carried out in Pittsburgh or Florida, if the temperature and other conditions in the room are the same. The climate does not affect the results of the accelerated test, provided all the factors are controlled.

M. P. IDING DISC GRINDING COMPOUND COMPANY
Incorporated

Announces the removal of its main office and factory from 3739 North Twenty-Sixth Street to 3534 West Pierce Street, Milwaukee, Wisconsin.

The new quarters, to be occupied May first, will provide added facilities for the manufacturing, handling and carrying of the various types of Iding polishing cements and Iding disc grinding compounds and for the rendering of efficient service to its customers and distributors throughout the United States and Canada.

Zinc Plating

By OLIVER SIZELOVE

Read before Chicago Branch

THE limited quantity of cadmium that is available for the plating industry and the increase in price of same compel those who are doing cadmium plating for protection against corrosion to revert to zinc plating.

Before cadmium plating was used commercially zinc plating was used almost entirely for corrosion and resistance purposes, due to the cost of cadmium and its salts. As the demand for cadmium increased, the production of cadmium increased also, and the price decreased so that it could be used on a comparable basis with zinc. The price of cadmium has always been considerable higher than that of zinc, but the character of the deposit made it more acceptable to the trade, and what the trade demanded it was necessary to produce.

The color of the zinc deposit from an Alkaline zinc solution is not of a very pleasing nature and it also has a decided tendency to tarnish more readily than deposits of cadmium. To overcome the tarnishing properties and also to produce a deposit very closely resembling cadmium, deposits of bright zinc are being produced. The supply houses that sold cadmium were compelled, with very little warning about the cadmium situation, to immediately produce bright deposits of zinc.

In zinc plating either the acid or a zinc bath may be used, but the cyanide bath is preferable because it has better throwing power than the acid bath. The acid bath however is considerable cheaper to operate.

Deposits produced from the sulphate solution under favorable operating conditions and in the presence of addition agents are usually brighter than those obtained from alkaline solutions.

The cyanide bath however can not be used for plating certain malleable and other iron castings without the addition of some other metal salt which deposits with the zinc. If mercury is present in the solution the difficulty is removed to a great extent and the throwing power of the solution is increased.

With some castings where difficulty is obtained in producing a deposit of zinc, the work may be plated in a cadmium solution

until the surface of the work is completely covered with cadmium and then transferred to the cyanide zinc solution.

The theory that has been advanced for the cause of the trouble in plating on cast and malleable iron from the cyanide solution is a low over-voltage of hydrogen on these metals so that most of the current deposits hydrogen. The presence of mercury brings the discharge potential of hydrogen so near the potential of zinc that zinc will be deposited together with a small percentage of mercury.

There is no trouble in depositing zinc on zinc in a cyanide bath in the absence of mercury and the main benefit of the mercury must be in getting the zinc deposit to form on the iron cathode at the start.

A simple explanation of how this has been brought about is that the mercury being the most electro-positive of any cathion in the solution first deposits on the iron cathode in minute film so that the cathode surface is changed from iron to mercury. This film will then prevent deposition of hydrogen on account of the high over voltage of hydrogen on mercury and will assist the deposition of zinc on account of the fact that these two metals alloy. It does not make any difference whether the mercury is introduced into the bath by adding a mercury salt to the solution or whether it is introduced into the solution by alloying the mercury with the zinc in the anode. When mercury is alloyed with the anode less polarization is obtained and a corresponding less amount of sludge being formed in the solution.

The mercury in the solution at the time of shutting off the current is immediately precipitated upon the surface of the zinc anodes producing an amalgamated surface, which reduces the cause of this high hydrogen over voltage and renders the anode immune from chemical attack of the solution, when not being operated.

The gassing of the anodes while hanging idle in the acid solution is a measure of the chemical attack on the anode. At the same time it indicates the tendency of the acidity of the bath to decrease. Pure zinc anodes gas greatly, while very little gassing is noticed with the mercury zinc anode.

The formula for the acid zinc solution that is being used with good results is as follows:—

Zinc sulphate	—50 ounces
Aluminum sulphate	— 3 ounces
Ammonium Chloride	— 2 ounces
Sodium Acetate	— 2 ounces
Corn Syrup	— ½ ounce
Water	— 1 gallon

The solution is operated at a room temperature with a pH of 4 to 4.5 and a current density of 15 to 25 amperes per square foot. The control of the pH being the most important factor.

The effect of the aluminum sulphate, ammonium chloride or the sodium acetate is due to their buffer action and this is so especially of the aluminum salt. In the concentration of the aluminum salts used in this solution aluminum hydroxide begins to precipitate at a pH of about 4. In such solutions the appearance of a white gelatinous precipitate is evidence that the pH is at least 4. So long as any appreciable amount of the aluminum salt remains in the solution the pH cannot exceed 4.5, as any decrease in acidity through chemical action on the zinc anodes causes more aluminum hydroxide to precipitate. This in turn can be re-dissolved by the careful addition of sulphuric acid. The introduction of a small amount of cadmium sulphate to the acid zinc solution produces a brighter deposit. As little as .04 of an ounce per gallon has a decided effect.

The formula for cyanide zinc solution that is being used with good results is as follows:—

Zinc cyanide	— 8 ounces
Sodium cyanide	— 5 ounces
Sodium hydroxide	—10 ounces
Water	— 1 gallon

One fourth of an ounce of mercury cyanide per gallon should be added to this solution if pure zinc anodes are used. The solution is operated at a temperature of 75 to 80° F. and a current density of 10 to 20 amperes per square foot is employed.

The deposits obtained from this solution are of a good color but not as bright as some of the bright solutions that are being operated today.

There are several bright zinc solutions on the market due to the demand for bright deposits of zinc. They all contain some brightening agent and also employ the use of a bright dip to produce a bright deposit. Some call for the use of pure zinc anodes

and some for alloy anodes. The operating conditions vary somewhat but in general a high current density is used in producing bright deposits.

The Hanson Van Winkle bright zinc solution which is known as the Mazic process yields zinc deposits which are bright and lustrous and the following conditions must be observed to obtain the best results. The solution is made using 8 ounces of zinc cyanide, 5 ounces of sodium cyanide, 11 ounces of sodium hydroxide and 1½ gallons of Mazic brightener to 100 gallons of solution. Zinc salt furnishes the metal ion to the solution and 8 ounces of zinc will yield about 4.5 ounces of zinc per gallon. The metal content may vary from 4 to 5 ounces per gallon. With 8 ounces per gallon of zinc cyanide and 5 ounces per gallon of sodium cyanide the total cyanide concentration in the solution will be around 12 ounces and it should be maintained between 10 to 13 ounces per gallon according to the type of work being plated, the higher amount being used when plating deeply recessed work and where high throwing power is needed.

The sodium hydroxide content of the Mazic solution is higher than that used in ordinary zinc plating, 10 to 12 ounces being necessary. The sodium carbonate content should not be allowed to increase over 10 ounces per gallon and when this amount has accumulated in the solution, a very decided gassing around the cathode is noticeable during plating. Usually rapid carbonate formation results from using higher voltage than is necessary and allowing the solution temperature to rise above 110°F.

While 1½ gallons of Mazic brightener is recommended for 100 gallons of the plating solution, a considerable excess of the brightener may be used without harm, but for economy and other reasons only the recommended amount should be used. When the brightness of the deposit diminishes after doing considerable plating, the brightness is restored to the work by adding Mazic brightener.

At times a defficiency in the free cyanide content of the solution produces deposits that are not bright. The free cyanide content should be checked before adding the brightener. After the addition of the Mazic brightener to the solution, it must be stirred thoroughly. A newly made Mazic solution usually yields bright deposits, but after the solution is electrolyzed at a normal

current density the brightness of this deposit is increased. The brightener is inflammable and should be kept away from fire and sparks.

This solution is operated at a voltage between 3 and 4 and a current density of 45 amperes per square foot. The solution should be operated not below 75° nor above 110°F. Unlined steel tanks are used. After the work has been plated, it is necessary to rinse it thoroughly before it is bright dipped. The work is dipped for a few seconds in a bright dip which consists of ½ of 1% nitric acid solution. After the dip, the work is rinsed in cold water, then dipped in a solution of 2 ounces of sodium cyanide per gallon of water, cold water rinse, a hot water rinse and dry.

A bright dip produces a uniform lustre surface and largely prevents finger marking during assembling or packing operations. The bright dip should be renewed daily or as often as is necessary to get proper results.

The samples that are being submitted, and which were plated with the Du Pont process were plated at a temperature of 75°F. and a current density of 20 amperes per square foot. It is possible to plate in this solution up to 60 amperes per square foot but it would require also an increase in temperature. One of the chief features of this solution is the wide range of conditions under which it may be used. If high current density is important, this can be obtained by an increase in temperature. If current density is not important the bath can be operated at ordinary temperature.

The samples plated by the Udylite Company have been plated in a solution containing 4½ ounces of zinc, 10 ounces of caustic soda and 9 to 11 ounces of total sodium cyanide. The higher cyanide content is used for barrel plating. An organic brightener is added to the solution which helps in producing a greater refinement desired and makes the plating solution less sensitive to impurities. Plating densities vary from 10 to 15 amperes per square foot. The anodes are pure electrolytic zinc balls placed in their standard anode container and the temperature is ordinary room temperature. The samples were bright dipped in a hydrogen peroxide bright dip. The large parts are still tank plated while the small parts are barrel plated.

With the Grasselli process a prepared salt is used in making the solution. One and a half pounds of this salt should be used to

a gallon of water to which is added .1 pound per gallon of the AAZ addition agents. In making this solution, it is recommended that the salts be dissolved in approximately one half of the total solution of water required. After the salts are dissolved, the brightener is added and the solution is thoroughly agitated for 1 to 2 hours. The solution is then made up to operating volume and if necessary allowed to cool to under 90°F.

A current density of 15 to 50 amperes per square foot is recommended, a temperature of 70 to 75°F. and a voltage of 3 to 6. The nitric acid bright dip is suggested to be used as a bright dip for this work. The work is dipped in the bright dip for 20 to 30 seconds. It is important that the work be thoroughly rinsed before bright dipping.

Grasselli's unalloyed zinc anodes are used and since the anodes tend to dissolve in the solution upon standing, it is necessary that they be removed from the solution when same is not in use for two to three days or more. Due to the high anode efficiency and the tendency of the zinc to dissolve even without the application of the current, the zinc content should be maintained easily and it should always be maintained around 4½ to 5 ounces per gallon. The total cyanide content should be kept within the limits of 12 to 15 ounces per gallon.

The caustic soda content, for proper efficiency, should be maintained between 9 to 11 ounces per gallon. The concentration of the AAZ brightening agent is not critical. In preparing a new bath .1 pound to 1.6 per gallon is recommended but if twice this quantity is used, no ill effects upon the deposit will be seen. When adding this brightener, the solution should be thoroughly agitated.

In the operation of the solution the most vital point is the obtaining and maintaining of the purity of the solution and the presence of any foreign metals, especially lead, is detrimental. Due to the presence of many small amounts of impurities, best results may not be obtained until after the solution has been electrolyzed for several hours at a low current density.

The supply houses who are interested in doing bright zinc plating have been kind enough to furnish me with data on the operating conditions of their solutions and also have submitted samples plated in their solutions, and which are on display for your inspection. They also have literature describing their type of solutions, which may be obtained by those interested.

I am including in the paper certain abstracts from the literature that I have received from the companies that have bright zinc plating solutions, so that a general comparison may be made from the results obtained.

From the samples submitted I wish to say that all of the different solutions give very excellent results and I wish to thank those who have assisted me in presenting this paper.

A Rapid Method *of Determining* Boric Acid *in Nickel Plating Solutions*

By M. H. LONGFIELD
CHICAGO BRANCH

Read at Chicago Branch Meeting

As it is generally admitted by many authorities that there is no simple or rapid method of determining the amount of boric acid in nickel solutions, this paper was prepared from the results of nearly three-thousand tests with different indicators and methods for determining the amount of boric acid in nickel plating solutions. The test is not an accurate analysis, but it will give a fair estimation of the boric acid in most nickel plating solutions within a $\frac{1}{4}$ of an ounce per gallon.

The nickel concentration, ammonium salts up to ten ounces per gallon sodium and manganese sulphate up to thirty ounces per gallon, sodium citrate, sodium tartrate, and sodium acetate up to four ounces per gallon do not interfere with the tests.

Amonium salts above ten ounces per gallon, sodium acetate above four ounces per gallon, sodium flouride above one ounce per gallon, make the test too low. If the quantity of glycerin is increased two or three times in the presence of flourides, the estimation is better.

The indicator is made by neutralizing one hundred cc of glycerin with ten to forty drops of one tenth normal sodium hydroxide solution, using phenolphthalein to just a pink color. Warm the glycerin to about 150 degrees F. to dissolve about two one hundreths of a gram of methyl red. (That is the point of a pen knife covered with it. The exact amount is not essential.) The indicator should have a clear cherry red color, not too dark. The methyl red must not be dissolved in the glycerin much above one hundred fifty degrees F.

The determination is carried out by adding five cc of the nickel plating solution, to twenty-five cc of glycerin, if the solution has a low pH neutralize the free acid by titrating with a one tenth normal solution sodium hydroxide, using methyl orange. (When the nickel solution has a green color in the presence of methyl orange, it is usually neutral, acetates and flourides interfere.)

When the nickel solution is neutral titrate the boric acid by putting five drops of the indicator in a cup on a drop reaction-plate, a drop of the solution being titrated is stirred into it, if the color does not change, another test must be made in the same manner in another cup. When the indicator turns orange color, that is the end point, yellow is too far. To run the test past the end point and then pick out the orange color is preferable, sometimes the indicator does not take the correct color for about a minute.

As six cc of the tenth normal sodium hydroxide solution are equal to one ounce per gallon of boric acid, the number of cc used in the titration divided by six will give the ounces per gallon of boric acid in the nickel plating solution.

Some experience is needed in carrying out the test such as mixing a drop from the end of a stirring rod, the drop must be seen but not fall off from a three sixteenth inch glass rod. The indicator must be in excess of the solution mixed with it.

Many other tests have failed; this paper is very short but I believe very practical.

Invitation to New York in 1937

The officers and members of the New York Branch are mighty happy at this time to extend a very genuine invitation for the 1937 convention of the American Electro-Platers' Society to be held in Manhattan.

As you will perhaps recall the Supreme Society is an out-growth of the original New York Branch, yet in some twenty-seven years not one national convention of the Society has been held here.

At the next meeting of your local branch we will sincerely appreciate having some action taken whereby your elected delegates to the Cleveland Convention will react favorably to our invitation.

On to New York City in 1937!

JOHN E. STERLING,
Chairman New York Convention Committee

A Critical Study *of* Bright Nickel

By LAWRENCE E. STOUT
Washington University, Saint Louis, Missouri

Paper presented at the annual meeting of the Saint Louis Branch of the American Electro-Platers' Society; February 1, 1936.

THE production of bright nickel without buffing is a valuable and desirable accomplishment. It has the obvious advantage of eliminating time, labor, and equipment now required for the buffing operation. There is always the further hope that such a bright deposit might improve the quality of the chrome plate which is usually applied to the nickel. Bright nickel plating is uppermost in the minds of most platers today, so it seems desirable to survey the accomplishments in this field in an impartial manner and determine if possible how valuable is this much heralded development in the science of nickel plating.

Addition agents for nickel plating are not new to the electroplater. Years ago his "shop secrets" consisted of periodic additions of corn syrup, condensed milk or the like to his nickel bath. Such dosages produced a temporary change in the appearance of the plated ware from that tank. These changes were usually for the better, unless too much brightener had been added. In other words, he knew that there was an optimum quantity to add to his solution.

Plating conditions have changed tremendously since the good old days when "Karo" or canned milk were secret and magic reagents. First and foremost of these changes is in the attitude of the plater himself. He soon realized that an interchange of secrets was essential to the betterment of the art. He confessed his secrets to his fellow workers and, in turn, learned many helpful facts from his brothers in the industry.

This change of attitude of the plater opened the doors for the real development that the industry has experienced in the past two decades. There had to be a critical study on the formulation of plating baths. Many of the constituents which had been considered essential were found worthless or even harmful. Plating formulas became simple and intelligible to the man who had

mastered the fundamentals of electrodeposition either by training or experience.

A further change in plating practice followed the marketing of high purity metals and plating salts. These resulted from the increased skill of the chemical and metallurgical engineer in producing these highly purified metals and salts. Ninety-nine plus nickel anodes necessitated a careful study of anode corrosion and demanded a reformulation of the nickel plating bath to insure adequate anode corrosion. Today it is easy to prescribe high chloride contents to facilitate anode solution but it was no simple task to correct this operating trouble which appeared when such anodes were first substituted for the lower purity variety.

When the plater was supplied with high grade salts and anodes one of his biggest enemies went out of the shop. Most of the platers did not realize this fact then and many will not admit it even today. Those impurities have been classified in many ways. Some were soluble in the bath, some insoluble; some were harmful to the deposit, some benefited it; some increased current efficiency, some decreased it. However, many of these impurities were just "plain dirt" in the plating bath.

This dirt in the plating bath has done more to destroy the high luster of a plated surface than any other one thing. The writer has stressed repeatedly the necessity of a clear, clean solution and the manifold advantages of filtration upon the character of the deposit. The writer is thoroughly convinced that in this direction lie many of our coming improvements.

However, when we look at the other side of the picture we know that some foreign substances produce beneficial results in a plating bath. Chief among these "addition agents or brighteners" are: Inorganic salts-cadmium chloride or sulfate; Sugars - sucrose, corn sugar, malt syrup; Colloids - gum arabic agar, gelatine, egg white, casein; Hydroxy organic acids - lactic acid, malic acid, citric acid. In addition to these simple addition agents there are a number of patented brighteners on the market. Some of these are colloidal brighteners containing no metallic salts while others are salts of complex organic compounds. Still others attempt to combine the advantages of each.

Now, as a chemist examines these patented brighteners from a theoretical standpoint, one is impressed by the fact that they hold much in common with our older practices. One notices on the one hand an increasing tendency to add colloidal materials that will aid in the precipitation of undesirable particles suspended in the nickel plating bath. On the other hand he detects an increasing use of complex organic compounds, such as aromatic polysulfonic derivatives, organic hydroxy acids or their salts, and finally complex polyhydric alcohols such as the glycols. Just what, then, is the new development in bright plating?

In an attempt to answer this important question a series of studies was made in this laboratory under the supervision of the writer. These investigations make no attempt to approach the problem of bright nickel from a theoretical angle. The experiments were undertaken to obtain some comparisons which would be useful to the practical plater who is honestly looking for facts which were collected in an impartial manner by a disinterested party who has no hint of financial interest in "patent rights."

For the first time in the writer's experience, a distinct lack of cooperation was manifested. About half of the companies "licensing" the use of patented brighteners ignored requests for price quotations on small amounts for experimental purposes. Two companies cooperated generously, even to the extent of furnishing the needed amounts of materials without charge. This refusal to cooperate on the part of the other licensing companies necessitated a most complete survey of the patent claims and an attempt to evaluate their products in terms of their disclosures made in patent literature.

The writer feels justified in mentioning the above facts before a group of men such as the Saint Louis Branch of The American Electro-Platers' Society because he feels that such a spirit is seriously antagonistic to the aims and purposes of the organization itself. If such an attitude persists, progress in the art of electroplating will inevitably slow down.

The very nature of such an investigation as this one auto-

matically precludes the use of names in connection with the results reported. However, in so far as possible, each brightener or product described in patent claims was examined under the prescribed conditions and in addition its brightening ability was tested on a typical single salt bath of:

Nickel sulfate,	12 ounces
Nickel chloride,	4 ounces
Boric Acid,	2 ounces
Water,	1 gallon

In addition, each brightener was compared with such commonly used addition agents as lactic acid, malic acid and glucose (corn syrup).

Glucose as an addition agent showed the usual improvement over the regular plating bath, when used in the proper amounts (1½ to 2 ounces per gallon). Malic acid produced a very soft, brilliant and shiny deposit at low current densities and at concentrations of 1 ounce per gallon. However, its intolerance to variations in operating conditions was marked and serious. Unless the bath were maintained under carefully prescribed conditions, a black nickel ooze formed at the cathode. This was easily wiped off but it represented a loss in current efficiency in the system. Lactic acid was inferior to malic acid as an addition agent. Nickel deposits from these baths were yellow and of poor luster.

Patented brighteners likewise showed a wide variation in the benefits obtained. One material was very good, when used under carefully prescribed conditions, including low current densities. It achieved a fine, smooth and bright plate. None of the solutions, however, solved the problem of a brilliant nickel deposit (by which the writer means a surface of mirror-like reflecting power). Microscopic examination indicated that the best of the bright nickel plates obtained had a crystalline structure which diffuses light rather than reflecting it. In no case did a surface approach the character of chromium plate.

Moreover, the performance of the brighteners is not consistent. Under the prescribed conditions the results are good.

These "bright plating solutions" are highly intolerant of variations in operating conditions. Their action under such conditions is similar to that described above for malic acid. In other words, then, these bright nickel solutions demand a more careful control of plating conditions than is customary practice today. The writer does not object to accurate control of the plating operation. However, he does feel that this is a point which should be considered by a man contemplating the use of such a solution.

The writer earnestly hopes that the results indicated in this investigation will be interpreted as they are intended. The man who is considering the installation of a bright nickel solution should know the liabilities of the process at the same time that he is advised of its merits and advantages. He should realize that most of the patented brighteners will benefit the quality of work obtained from a single salt bath such as described in this work. However, the writer still must say that, in his experience, no such bath has given consistent results under irregular loads unless the composition and turbidity of the bath are carefully watched. Moreover, no sample of bright nickel has been produced in this laboratory that could be called "brilliant" in its reflecting powers. Likewise, no sample has been produced here that will take as smooth and delightful appearing a deposit of chromium as a properly buffed nickeled surface will assume.

There is no doubt that bright nickel has a valuable place in modern production where plating costs must be held to a minimum. One must circumscribe its bounds of recommended usefulness, defining its advantages and acknowledge its shortcomings. Then the plating trade will escape the disillusionment that it suffered in the early days of chromium plating. One must balance the assets of bright nickel against its liabilities and in this way carefully study the advisability of such an installation. Then, if one decides that his problem can be met to advantage by procuring such a license, he will not expect that license to deliver to his shop a little fairy which is capable of relegating to the past all of the well known plating troubles. Bright nickel is not a magic wand but is a competitive commodity which should be offered on a service basis to the public.

The **Mechanism** *of Electroplating*

HIRAM S. LUKENS

Read at Bridgeport 1935 Convention

MR. Chairman, Fellow Members: I wonder if it is necessary for me to torture myself with this microphone. I know I won't be able to stay near it. I am wondering if those of you in the far corners can hear me without it. If you will permit me to try, I should like to, and in the event you fail to hear me, if you will be good enough to signal to that effect, I shall try to return to the microphone.

My topic suggests a knowledge, a more or less profound knowledge, of the process in which we are all very much interested, but I must confess and prepare you beforehand not to expect that it is at all a complete story of that process. We are very definitely of the opinion, as a whole, that it involves several processes, that which takes place at the anode, for example, when the metal passes into solution, a subject about which I feel we know very little.

The mechanism relating to the phenomena at the interface between an anode and a solution in which it is dissolving is something about which we have speculated a great deal, but regarding which we have very little experimental evidence. At the cathode, knowledge is better advanced, because most of us are giving attention to the type of product which is produced at the cathode, and that is what concerns us, primarily, and that is what we have studied most. What I have to bring to some of you tonight is, I hope, new material, and to many it is a repetition of something they have heard me say before, for which I apologize.

The subject represents an effort to ascertain a little more information regarding what is transpiring in the solution between anode and cathode. It was prompted by an effort of longer duration than I like to confess, to try to find a satisfactory explanation for the difference in thickness of deposits produced on a plane surface by electrolysis.

Under ordinary conditions the deposit is invariably thicker at the edges than it is toward the center of a plane rectangular plate At any protruding point on an object which is being plated, we have an increased thickness of deposit as contrasted with points which do not occupy such a position in our solution.

The subject was attacked, first, by investigating the distribution of current density across the surface. That had been investigated by others and the results all confirmed one another, in that current densities are invariably higher at the corners of a rectangular plane surface and decrease as we approach the center of that surface. That seems to be a fact. Why it should be so is not explained by the simple observation that it is a fact.

Another attempt to attack the same problem involved an effort to measure the potential drop at various points on a plane surface, and it was found that at the corners of our rectangle, again, we have higher potential drops than are detectable at any other point on the surface, the potential decreasing again as we approach the center of our plate. But that difference is exceedingly small, and differences can only be detected by most accurate and painstaking measurements.

Some light, I believe, is thrown upon the problem by some experiments made with the object of ascertaining the potential drop throughout the solution between anode and cathode. If we make those measurements, we find that there will be a series of points in our solutions at which the potential drop is the same, and if we draw lines through those points that are all at the same potential, we ascertain that those lines have a definite contour, and the contour of those lines does seem to throw some light upon this problem and suggest means for so modifying conditions that the potential drop may be made more uniform, and, in consequence, the thickness of the deposits may be made more uniform.

The problem of determining these equal potential lines in conductors dates back to the early part of the last century, in the neighborhood of 1845, when measurements were made by Kirchoff in Germany, investigating the conditions in metal plates. The subject was not again taken up extensively until the latter part of the century, along in the 1870's, when British physicists

interested themselves in the problem and began to apply mathematics to predicting where these equal potential lines would go. A few of them were plotted.

The investigations were confined mostly to metals. A few determinations were made in solutions by a method which I hope to illustrate to you shortly. Coming back to the generally accepted explanation for this difference in thickness of deposits on a plane surface, I think I can make it better apparent by the first slide, if I may have it, please.

(*Slide No.* I) In this slide we have illustrated a type of explanation which we will find in most of our texts and articles on the subject. The illustration here represents an anode and cathode of the dimensions indicated by these lines, and our principal current flow is supposed to be along straight lines, as indicated by these lines "A", but the explanation which is commonly offered for the fact that the deposits at the cathode are thicker at the edges and corners than they are in the center, is based on the assumption that stray lines of current flow are to be found in this region of the solution, out and beyond the portion of the solution that would be bounded by the dimensions of anode and cathode.

These measurements, as illustrated by these graphs, apply to the lines of flow, or the resultant lines along which the ions would flow in migrating from anode to cathode. Our equal potential lines are lines which cross these at right angles, indicating the potential drop at those points, which are connected by those lines, and indicating that the points are all at the same potential. The first measurements made in solutions were made by a Professor W. G. Adams in England, by using a device illustrated in the next slide.

(*Slide No.* II) This represents the tank in which he had his solution. The principal current from his battery was flowing through this circuit indicated here, and between the electrodes marked "A" and "B". Here are wires supported on T-shaped pieces, resting on the edges of the tank, so that they could be moved about into any position whatever. These two pencil-like electrodes were connected through a galvanometer, indicated

here. By keeping one of these electrodes in a fixed position and shifting the other, he could tell by the magnitude of the deflection of the galvanometer when these particular electrodes were at points of the same potential. By that means he was able to plot a few lines in copper sulphate and zinc sulphate solutions, simply illustrating the general principles which the mathematicians had worked out as explaining the contour which the equal potential lines should have in metals or in solutions.

The experiments, the results of which I plan to show you, were made with a little different device. Instead of using a tank so deep, a very shallow glass vessel was used, on the bottom of which was placed a piece of cross-section paper, so that by looking down through it you could see the markings on the cross-section paper. In place of electrodes supported in this manner, two electrodes were used, one of which could be held in place by a clamp and the other of which, moved by hand, could be shifted around over the bottom of that shallow vessel, which was only, perhaps, five millimeters in depth and contained a solution that was not over three millimeters in depth. By looking down we could note the positions, then, on the cross-section paper which the electrodes occupied, and then translate those measurements to a similar piece of cross-section paper and finally obtain a series of points, all of which were at the same potential, and draw lines through them which would illustrate the equal potential lines in that very shallow solution.

According to the predictions of the physicists and mathematicians, if we had a rectangular vessel, the ends of which constituted the electrodes between which the current was passing, then current should flow in straight lines from one electrode to another in parallel lines, and the potential drop should be regular and uniform from one electrode to the other, and the lines of current flow should all be parallel, and the deposit should be uniform on such electrodes.

(*Slide No.* III) The next slide illustrates measurements actually made to test that prediction. This was a rectangular vessel of the shape I have just described, a shallow glass dish, roughly about a foot in length and about seven or eight inches in

width. The electrodes used—anode and cathode—were of platinum foil, extending all the way across the ends. One of the exploratory electrodes which was connected to the other by wire and with a galvanometer in series, was placed at the points encircled. The second exploratory electrode was then moved across the bottom of this dish until a point was found at which, when the main circuit between these two electrodes was closed by a tapping key, there was no deflection of the galvanometer, indicating the two points were at the same potential. In that manner points such as these were found and the line connecting them.

We seemed to be justified in plotting an equal potential line (connecting such points) and in assuming that the potential drop between this electrode and that line or any point on that line and between this electrode and any point on that line was the same. In that manner all of these lines were plotted, and you will note they are perfectly straight and perfectly regular, and that we would expect, under these conditions, to have an absolutely uniform deposit produced on our cathode surface. But let us look at the picture if we use electrodes something smaller than these, and place them in a different position within our vessel in which the electrolysis is taking place, our next slide, I think, illustrates that.

(*Slide No.* IV) Here is our rectangular vessel indicated by these outside lines in which were placed two platinum electrodes, indicated by these points here, between which our principal current was flowing. One of our exploratory electrodes was placed at a point such as this in a fixed position. The second one was moved about until the point was found that was at the same potential, which would give us a series of points like that, exploring the whole solution. This happened to be a sodium sulphate solution. A solution of any other salt that I know of might have been substituted—a water solution, or alcohol solution, or a good or bad conducting solution, irrespective of what it was. The contour of these lines with the electrodes placed in that position within a vessel of these dimensions would be identical in every case.

It brings out rather forcibly, it seems to me, a fact that I do not believe we always think of. Not only is the portion of the solution between our electrodes electromotively active in contributing to conductance of the current, but every part of that electrolyte within the confines of the retaining vessel is polarized, and it is only reasonable to suppose that with that drop in potential existing between the extreme points within this electrolyte and the electrides, there will be ionic migration toward the electrodes, the ions migrating to the electrode of opposite sign.

Furthermore, the contour of these lines indicates that the potential drop throughout the electrolyte is not uniform by any means. The potential drop per unit distance out here is certainly something very much greater than the potential drop per unit distance here, and since our theory indicates that the rate with which our ionic ions migrate is dependent upon the potential drop per unit distance, their velocity here must be something very different from what it is out here. Their velocity here must be something very different from what it is within this region, and we could picture our migration or velocity, rather, of our migrating particles as being very much accelerated here, slowing down and accelerating again until it reaches the opposite electrode.

(*Slide No. V*) Here we have done nothing except translate our two electrodes from a symmetrical position on the center line between the sides of the vessel, translating them a centimeter and a half toward the side of the vessel. Picture the distortion which that produces, the very obvious difference in current concentration throughout the different parts of the electrolyte produced by simply moving our electrodes from a symmetrical position to one nearer the edge of our containing vessel.

(*Slide No. VI*) The next slide is an illustration of what happens when we have two electrodes which are plane surfaces. These were two platinum foil electrodes supported in a symmetrical position again. Here we find what seems to me to be a satisfactory explanation for this difference in distribution of deposit at an electrode surface. Examine this line nearest the electrode, for example. The potential drop per unit distance here is cer-

tainly something different from that which we have here, the potential drop per unit distance being appreciably greater as we approach the edges. Hence, we would except that a greater deposit would be produced within this region than we would expect to have here. We see, also, that there is a definitely existing potential drop from parts in our solution in this region just as well as within portions within this region, and we find an explanation of why we have deposits produced on the back of our plated objects, even through our anode may be over in the position indicated here.

(*Slide No. VII*) The next slide shows what happens to our equal potential lines and our resultant lines of current flow if we translate these electrodes from a symmetrical position down toward the lower edge of our containing vessel, and we have no reason to expect that we would achieve anything like the uniformity of deposition under these conditions that we would were it placed on the central line of our electrolysis tank or container.

(*Slide No. VIII*) Here is an effort to picture the equal potential lines, using an electrode which, in this case, was a platinum rod, and in this case was a piece of platinum foil bent into the shape indicated. We see here a very good illustration, or a very satisfactory explanation, I think, of why it is just about as easy to produce a deposit in the middle or the back of a vessel of that contour as it would be down in the corners which you know are so difficult to cover when you have vessels of that kind to be plated.

(*Slide No. IX*) The next slide does not tell us very much more, except to illustrate what happened when we substituted a plate electrode for the smaller rod electrode in the previous illustration. You see, again, the same general effect and an explanation of the high concentration of deposit on projecting edges or prominent places, such as we see here, and which is again an illustration of the equal possibility of producing a deposit here as well as in that point.

(*Slide No. X*) Here is a comparison of the results obtained by spacing our electrodes at different distances apart, the positions being about those indicated in these two slides. You will

note that by the effect which many of you have observed in actual practice, bringing the electrodes closer together does tend to improve the penetration or possibility of improving the deposition in these recesses and tends to minimize the deposition in a position such as this.

(*Slide No. XI*) Here is an effort to find out what would happen in the case where a broader anode surface was substituted for the very small one used in the previous illustration. You will note here that the principal difference which we detect is in the effect out in this region. Comparatively little difference is produced within the vessel. There is scarcely any deeper penetration, although slightly so, where the larger electrode is used, but it does have a more marked effect outside.

(*Slide No. XII*) Here is a comparison of conditions which exist in the case of a metal conductor with a conducting solution of uniform concentration. These graphs were obtained by substituting a sheet of tinfoil of exactly the same dimensions as the dish which we used previously, placing our electrodes in position on that tinfoil just as we had immersed them in the solution previously, and placing the exploratory electrodes in the positions which produced lines of the contour which you see illustrated there. You recognize the lines as being certainly very similar to those which are found in solutions.

(*Slide No. XIII*) The next slide illustrates what happens when the electrodes (using tinfoil again) were translated from the symmetrical position to one nearer the edge of the tinfoil. The same type of distortion of the lines results as that which we noticed in the case of solutions.

(*Slide No. XIV*) In the next slide we have a comparison of the lines which were obtained in the sodium sulphate solution which we brought to your attention previously, with the lines which were obtained on a sheet of tinfoil. You will note, if you take lines that go through similar points, that their contour is absolutely identical. There is no difference whatever, and it certainly suggests that the type of process which we encounter in conductance in metal is not too dissimilar from that which we encounter in conductance in solutions.

(Slide No. XV) The next slide illustrated a comparison of the distortion produced by translating electrodes in a solution into this position with the distortion in the symmetry of the lines produced in the case of tinfoil, again. You may wonder why there are not as many lines in this illustration with the metal as there are with the solution. The reason is that they are a whole lot harder to make, and we thought we had enough. It is not so easy to pick out points, although I believe were we attempting it again we would be satisfied with simply punching holes in our metallic conductor and using those holes to plot our lines, but that had not occurred as a feasible procedure at the time these were made, so that we had to be satisfied with fewer lines. But if you will contrast the lines that go through similar points, you will find that they are identical in every respect, in the solutions as in the case of the metallic conductor.

(*Slide No.* XVI) I am sorry that this slide has not been cleared better. It is a little bit confusing. You see here the cross-section paper markings are still left on the slide, but in my haste to have it available I was afraid to take any changes, and brought it along anyhow. This represents an effort to gain some light on what happens when a cathode, represented by this heavy line here, is suspended between two anodes, represented by these heavy lines here, and to gain some idea of the distribution of the equal potential lines under those conditions. We see here two anodes and we have reason to expect a much more uniform distribution of deposit on a cathode, due to the influence of these two electrodes on one another, and there is entirely absent that marked convergence of the equal potential lines close to the cathode, which we observed when only a single anode and single cathode were used.

(*Slide No.* XVII) In this slide I have attempted to combine the results which were obtained in a circular containing vessel, and the section on to this side, to the left of the median line, represents the equal potential lines about a cathode when the containing vessel iteself was made of non-conducting material. They were results obtained in a circular glass vessel, using an anode which is in this position. Please disregard everything to

the right of that central line for the moment, and consider these equal potential lines that were produced about this cathode when it was polarized in a vessel that was made of non-conducting material.

Then contrast that with the contour of the equal potential lines to the right of the center line, which represent those which were obtained about a cathode with an anode placed in a similar position, but within a vessel whose walls were made of conducting material. In other words, we lined this circular vessel with copper. It became very evident that the conducting surface of the containing vessel exercised a very marked effect upon the contour of these lines, if we contrast this line with that one, which is exactly comparable to it, because these points are equally distant from the electrodes in both cases. The probable explanation would seem to be that the walls of the conducting vessel are acting as bipolar electrodes and are very much improving the distribution of current density on that surface as contrasted with this one.

I believe it would be quite possible to make some useful application of knowledge of this kind. If we had an object to plate upon which it was desirable to have an absolutely uniform deposit, or as nearly a uniform deposit as it was possible for us to make, why would it not be possible to construct a containing vessel to scale of substantially the dimensions of that in which we expected to do our plating; to construct a test cathode made to scale, in so far as its relation to the containing vessel was concerned, and test anodes made to a similar scale, and plot the equal potential lines that we would obtain on subjecting that anode and cathode to electrolysis? Then so modifying the dimensions of our containing vessel, or so placing guards or shields within our electrolyte, we could assure ourselves that the potential drop per unit distance within the region near our cathode was substantially the same at all points, or as nearly the same as we could bring it, and I would certainly be deeply disappointed if we were not able to achieve at least some improvement in the distribution of metal deposit across those surfaces.

Thank you for your attention. I hope that some of you may be inspired to gain more knowledge on this very difficult problem

of the mechanism of conductance, regarding which this is only, to my mind, a very small fraction. There is a serious need, and I hope an abundance of profit, to be found in further investigating what happens between an anode and cathode and an electrolyte.

Thank you. (Applause)

CHAIRMAN BLUM: We shall be glad to allow a few minutes for questions or discussion of this very interesting paper by Dr. Lukens.

MR. MEYER: I want to add one little thing which I think you overlooked in your discussion. You mentioned the newer paper previously, that is, the thickness of the deposit is inversely proportional to the distance of the cathode from the nearest equal potential line, or from the equal potential line. In other words, if you wanted to get an idea of the relative thickness of the deposit here and here, just measure this distance and measure that and it is inversely proportional to the distance. That is, of course, assuming the conductivity of the solution is the same throughout. In most cases it would be.

MR. PHILLIPS: Bearing in mind that both rubber-lined tanks and lead-lined tanks are in commercial use, would Dr. Lukens, from this last slide, prefer to use a lead-lined tank or a rubber-lined tank?

DR. LUKENS: In so far as the opportunity for improving the uniformity of current distribution is concerned, I would be inclined to prefer the metal-lined vessel, but we must remember that if that lining of that vessel is acting as an electrode, as it obviously is, then we must be prepared to anticipate what effect that will have upon the control of our solutions, and our choice would have to be a balance as to the magnitude of the influence of those factors.

MR. PHILILPS: In other words, you have both virtues and vices there.

DR. LUKENS: Precisely, as we always do.

CHAIRMAN BLUM: Dr. Lukens, on that point may I call attention to the fact that in electrotyping practice they sometimes use stoneware tanks and sometimes they use lead-lined tanks? If this difference were significant, it should be possible, by

an examination of the deposits, to find out if they were more uniform in one than in the other. I have no idea whether they are, but it could be done on a commercial scale.

DR. LUKENS: There is no question about it.

MR. GRAHAM. In connection with the question Mr. Phillips just raised, I should think that it would be of interest to know what benefit you might get in current distribution as indicated by your distribution of your equal potential lines in other than a circular vessel. I can conceive of a rectangular vessel in which you have great length and narrow width, in which you might have a condition that might not necessarily be as favorable as you have in your round vessel.

DR. LUKENS: I think that is quite likely. It is quite certain, I would say.

MR. GRAHAM: I am repeating something that my next-door neighbor mentioned, which occurred to me, also, and that is that I am wondering whether the suggestion Dr. Lukens has made about the possibility of using this method of attacking the problem of determining the optimum conditions as far as the placing of electrodes or guards is concerned for obtaining uniformity of deposit, is not going to be simpler by using a laboratory attack of this kind than the cut-and-dried method that frequently is used.

MR. ERIC G. SAMPSON, JR. (Sampson-White Laboratories, Jamestown, N. Y.): I should like to ask you, Mr. Lukens, if you have done any work on using curved anodes in a rectangular tank to get a uniform deposit on a sheet and not have enlarged edges.

DR. LUKENS: I have not had any experience of that kind, but I have seen very uniform deposits produced on plane surfaces, or nearly plane surfaces, by supporting them in a rubber-shaped shield of about this shape (illustrating), where the anodes were in this region and the cathode was supported here. I have had no experience in attempting to modify the shape of the anode at all. The results of efforts in this direction were so gratifying that we deemed it inadvisable to tamper with the commercial anodes already available in a satisfactory shape. This is exaggerated, but it illustrates the general design.

MR. SAMPSON: My only point in asking that was that some-

times it is necessary to plate a flat sheet on both sides and keep the current uniform so that the deposit will be uniform.

DR. LUKENS: I would certainly suggest, as a means of attack to that problem, that you support such a plate between anodes, supporting your cathode sheet in that position, and protecting it with some such shielding device as this (illustrating). I believe that would work. However, in designing these, I should like to go back to the laboratory device which was a replica of what I proposed to use to scale and try to make any experiments. Make the shields on a smaller scale and then expand them to the work size.

CHAIRMAN BLUM: Are there any further questions?

MR. PROMISEL: Since a question of laboratory methods of determining the optimum conditions for plating has been brought up, I should like to mention a method that was recently used in Germany for determining the uneveness of deposits. (Illustrating) It was laboratory set-up, and if we consider this a glass cell again, we can figure this represents the cathode and this represents the anode. This cathode was split up so that it was made up of thin segments placed adjacent to each other, with insulating strips between each segment. The back of this was also insulated with a wax or some such material. To each of these segments an appropriate resistance was put in series with appropriate switches, and so forth, and then that was brought out to a very sensitive milliammeter and a hole connected to the anode. By the proper series of switches and resistances, this milliammeter could be shifted from one segment to another, and during the process of electrolysis, the actual current going from here to any one of these segments could be measured. The results were plotted in such a way, where these represented segments of the cathode, and in this direction the current was plotted.

If one ammeter were put in the anode circuit, this would represent the average current that was passing through the cell, and you then plot against each of these segments the actual current that was passing through each one of them. Various set-ups were used. For example, if there is a cell, the cathode could be brought very close to the anode, or it could be brought over there. In some cases, glass plates were put in such positions, and then

were moved either to the anode or toward the cathode, and the resulting curves looked something like this. If the plates were very close to each other, you got a curve that came something like that.

As we all know, at the edges one had a very high current and toward the center it was very much nearer the average. Now, if these two plates were brought further apart, you got a curve that went something like this. That is, perhaps, not entirely familiar to most of you, because I think we labor under the general impression that the greater the separation between the anode and cathode, the better is the distribution, and that is true, provided the cathode has a projection of some sort; but if you have two plates entirely plain and entirely parallel, then the distribution is actually better if you bring these two plates closer together, and I think a little thought will indicate that that is logical.

Confirming Dr. Luken's results, in using these two plates and bringing them close to the cathode in that way, the actual curve obtained was very much like this. You see it very closely followed the ideal current distribution. On the other hand, if these two glass plates were brought toward the cathode, when they were brought approximately three-fourths of the distance back to the anode, it was as though the plates actually did not exist. You went back to this original non-uniform distribution.

That all supports the general theory and the first slide, I believe, of Dr. Lukens' in which he had two plates like that and indicated the current lines going this way and then beginning to branch off so that you had concentration in that form. Some such arrangement might also be used in a laboratory way to determine the optimum plating set-up. You could use non-conducting guards; you could use conducting guards if you wanted to. You might move the whole set-up nearer the edge of the tank, if you wanted to. In fact, in one experiment these two plates were extended down that way and the resulting curve came very much like that. This part that was farthest from the end of the tank showed a very abnormal current distribution, whereas this part that was close to the tank followed the average current very well indeed, and that, I think, also confirms, from a different viewpoint, the results that you have indicated.

MR. HOGABOOM, JR.: Those are very interesting remarks, but to get back to another point that I think is probably being overlooked in this discussion, there is the fact that on these diagrams we are really looking down on top of the solution. We are taking an airplane view of the solution. If we get off to the side of the tank and look at it that way, we have a different arrangement of the equal potential lines. Remember, we have a three-dimensional system here. When you travel on a railroad train, you are traveling in two dimensions. In an airplane you have three dimensions. In a plating solution we have three dimensions. I just want to bring that out. We do not want to lose sight of that fact.

In the last slide on this point, it was pointed out the amount of deposit on here is inversely proportional to the potential from here to here and from here to here (illustrating) to the distance. That brings out another point to which I would like to call attention, and that is that we are trying to directly translate potential to metal. In other words, as soon as you say we have a proportion, you say potential is metal; inverse potential is metal, inverse metal. I would just like to call attention to the fact that when we double the potential we do not necessarily double the amount of metal, due to the fact that when we double the potential sometimes we plate out gas. We are interested only in metal. That is just a thought.

To get back to the first point, the three-dimensional system, the bottom of a cathode is at a different condition from the top, due to convection currents along the surface of that cathode. It has nothing to do with potential lines. The convection currents are set up due to the fact that at the bottom of a cathode we have a solution which is at a different density from that at the top of a cathode. At the top of a cathode the film adjacent to it is depleted in metal. At the bottom it is rich in metal. The film solution is traveling up along the cathode. That will change the picture of the solution in a vertical plane. This is the picture in a horizontal plane. We have got to have it. As Dr. Lukens has said, the whole problem is complicated and we know only a fraction of it. All I am doing in all this is simply pointing out one other small fraction that we must keep in mind. I am not giving any explanations.

A Tribute to Our Friends, the Technical Men

By George B. Hogaboom

Throughout this year you have been reading the papers presented at the Bridgeport convention by several technical men. That these papers have considerably advanced our knowledge of the operation of plating solutions and the deposited metals is too evident to require comment.

What probably has been not given much thought is the time and effort required to assemble the data and the reward received. The papers presented contained all new material and together material of the character the papers contained required more time than one can estimate. It is known that in research for new material much more time is consumed than contemplated. Training and years of continual education are also require ; and, with it, very often, expensive equipment. What was the reward?

Every man not only bore the expense of assembling the data obtained by intensive research but also defrayed all his expenses to be in Bridgeport and present to the A. E. S. the results of his work. Not one speaker was financially rewarded in any manner; their reward was only in the pleasure obtained in adding their contribution to the advancement of the electro deposition of metals. It is only through such commendable assistance that electroplating can advance—the plater is not in the position to contribute such new material—it is to the technically trained man that we are indebted for our real knowledge of the art of electroplating.

The A. E. S. members, one and all, owe much to the men who present papers at their conventions, especially to the professional men who gave so freely, and without a thought of reward, at the Bridgeport convention. Our regret should be that while these men are planning the way for greater developments in the work in which we are vitally interested we cannot accept them in the A. E. S. in the same equality of membership as a man who can contribute only a fraction of the essential knowledge of plating and often that is only from the experience in the operation of a process the scientific man has labored years to develop.

The A. E. S. owes a tremendous debt to our good staunch friends—the technical men.

Work and Money

By EDWARD H. TINGLEY
Secretary
National Association of Foremen

EVERYTHING you make will be used by somebody. Everything you use was made by somebody.

You are working for other people.

And thousands of other people are working for you.

Whenever you buy anything, you are buying the work of other people.

The question is, what kind of work are we doing for each other?

Think of all the things that you use, and see how the work of others enter into each one of them.

You go to the wall, push a button and get a light; you go to the sink, turn a handle and get water; you go to the garage, get into your automobile and drive away; or you get on a train and ride to a distant city.

Think of all the people who had to work to make the wires, light bulbs, faucets, plumbing, automobiles, and the trains before it was possible for you to push a button and get a light; turn a handle and get water; go to the garage and get into your automobile or take a train at the depot.

Think, too of all the people who are working, operating these things and keeping them in repair.

If everyone does his work well, all of these things work well for you. But if anyone works carelessly, these things may work poorly, or perhaps not at all. Then you are all upset and ready to say a lot of hard things, or mad enough to fight. Well, if you want other people to do good work for you, what about you doing your work well for them.

The other night some men were listening to the radio. The music was coming in perfectly from New York. One of the fellows said, "Here we are enjoying this music because a lot of people did good, careful work. I wonder if the people who did such good work in making this radio were to buy our products, if they would work as well for them as this radio is working for us?"

If everyone would think about such things and try to do his work as well as he could, he would soon rule out the worst thing we have to deal with, and that is CARELESSNESS. And if we would do this, everything could be made so much better, and so much cheaper, that all of us could have so many more of the things we want, and the making of all these things would make more work for every one.

That is what has happened in all those things where the price has come down and the quality has gone up.

Take for example the automobile. Few people could afford them if the price had remained as high as it was when they were first made. Then there would be only a few companies, with little work in each one, and only a few people enjoying the many pleasures and advantages of an automobile.

But, due to the good work done by many people, automobiles are now made far better than ever before, and are so much cheaper that many millions of people have bought them.

And the same is true of many things that are bought by people all over the world, and all this buying makes the work which pays the wages that make it possible for all to buy more and more things.

This is of greatest importance to every one, for when we are doing good work at low cost, it means with little waste. This means more things, more work and better values for all.

WHAT CAUSES HIGH PRICES?

Edward A. Filene has expressed this most clearly in his book "Successful Living in this Machine Age."

"What causes high prices? There can be only one answer. It is failure to follow methods by which prices can be made as low as possible.

In a word, high prices are caused by waste. Waste is the process of production and distribution is the great enemy of the consumer's dollar. Everything which the consumer buys, if he gets the fullest possible value for his money, gives maximum employment to other consumers, makes business as prosperous as business can be and enlarges the consumer's dollar. Every time, however, that the consumer pays more than the most scientific methods of production and distribution make it necessary for him to pay, there must be less buying than there might have

been, with consequent less employment and a further shrinkage in the consumer's dollar."

WHAT IS MONEY?

What is this "consumer's dollar"? Money—you say.

Well—what is money?

First: It is the medium for the exchange of work.

Second: It is the indicator which shows what kind of work you are doing.

All over the world people are exchanging work with one another and money forms the medium for the exchange and makes the exchange possible. For awhile gold was the standard money for all nations but now with only a couple of nations on the gold standard, the money of the various governments must be valued in relation to each other—or against a day's work or a bushel of wheat. Without money we could no more exchange work with others than we could exchange ideas without an alphabet.

Watch the next money you spend and see what you buy. Whenever you buy any thing you are buying the work of other people. Henry Ford said, "Materials cost nothing." How can that be? What he meant was that nature put the coal in the ground or caused the trees to grow, but man must labor to dig the coat or cut down the tree and saw it into boards which become a house, furniture or a packing box. We are then paying for the labor put on the raw materials, but not for the materials as such.

BUYING POWER OF MONEY

Money is an interesting thing in many ways. For one thing its value seems to change—that is, sometimes it will buy more than at other times. Even in the space of a few hours its buying power will double. Here is an illustration:

Last Fourth of July, late in the afternoon, I saw this sign: "All Fireworks, One Half Price."

That seemed odd—for at noon, only 5 hours earlier, I paid full price for some. What made this cut? The fireworks were just as good as ever, and cost just as much to make.

The same story could be told about the sale of straw hats in September. Four dollar hats for one dollar—the same quality hat but only a short period of summer left—so cut the price and sell the goods. The thing that establishes value is the work anything can do—so money is the medium for the exchange of work.

All of us can recall when we were boys, how far a dollar would go in the purchase of food and clothing. We brought home a whole basket full of groceries for that dollar. Today a trip to the store ruins a five dollar bill. Now what has gone wrong with that dollar? Simply this: in the earlier days of the 20th century men worked 10 hours per day for 2 to 3 dollars—approximately 25c per hour. So a dollar had stored in it a half a day of work—about 4 to 5 hours. But today it has stored up in it only an hour and a half, in many cases one hour of work.

So we can easily see why, as we buy the work of other people as represented in the goods they make, we must pay much higher prices than we did when labor was cheaper. On this basis we should expect to be paying 5 times the former prices but this is not true. What then, has kept prices down within reasonable limits?

WHAT KEEPS PRICES DOWN?

The use of labor-saving machinery, mass production and better planning of our work, has ruled out so much of the former waste, that we get more done in an hour than formerly was done in a day or more. This makes these products so cheap that greater numbers of people can buy and enjoy them and it also makes more work for more people. This is the goal that every leader in industry today is striving to reach—to pay as high a wage as possible, making at the same time a good product at a low cost. Our dollar, then can buy more and better things.

Waste is the only thing we control, in the lowering of costs. Every product must have a certain amount of materials, labor and accessories, and it is the problem of the factory executive and foreman to watch that no extra amounts are added that increases the cost. Waste can be in time, materials and energy and is often unnoticed because it seems small. If we are to pay high wages, it is most necessary that none of these wages go for poor work, idle time and the waste of energy and materials. Each of us at some time, is a purchaser and we want the best value for our money. The best product at the lowest price, is our request. So we should strive in our own shop to use our labor most effectively with the least waste thus insuring the lowest costs. For low costs mean more people can buy our products, which results in more work.

MONEY IS THE SCORE CARD

Money is the indicator which shows what kind of work you are doing. This was the second characteristic of money. Several years ago Mr. Ford said, "I have got more money now than I want, yet we go right on lowering the cost and making more money, for we must make money to prove the policy is right."

Every business is entitled to a profit, in fact it must have a profit to be able to remain very long in business. The long and severe depression has definitely shown the need for surplus reserve to carry the business when it was not able to earn a profit. The past few years have seen many industries close their doors and go into receivership because they did not have the money to carry on. The making of money proves that the design of your product is right because the public will buy it; the price is satisfactory for the customer will pay it and the cost is low enough so the company can earn a profit. Therefore your policy must be right and your business is successful.

If you are not making money, you are going in the wrong direction, and unless you can change that loss into a profit, you are going to pass out of the picture. All of us are familiar with the automobile companies, which have a most profitable year when their model "takes" with the public and lose money when the model is not attractive. The making of money is the score card of how you are playing the game of business.

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The Abstract Section

PATRICK J. SHEEHAN, *Chairman, Program and Educational Committee*

CHEMICAL AND METAL ABSTRACTS

1. Finish Foundation for Bare & Plated Steel — G. A. ENDOM, "*Industrial Finishing*" Vol. **II** -- March 1935, pp 9-11—Article discusses cleaning solutions and coatings employed, red Fe oxide oil base, lead chromate oil base and zinc chromate lacquer as primers. Gives results of exposure tests showing effectiveness of metal cleaning and durability of finish coatings.

PHIL J. RITZENTHALER.

2. The Finishing of Zinc Alloy Die Castings and Rolled Zinc. "Imperial Smelting Corp. Ltd."—95 Gresham St., London E. C. 2—Sept. 1935—Recommendations for polishing, cleaning, pickling, plating and rinsing of Zn. Direct nickeling of zinc for an undercoat for chrome is preferred. Composition of nickel solution is 12 oz/gal. nickel sulphate, 2 oz. sodium sulphate, 2 oz. ammonium chloride and 1½ oz. boric acid operated at Ph of 6 at 75° F. Bright nickel deposits obtained by addition of cadmium sulphate are smooth and bright but highly stressed and brittle. They are not advocated as undercoat for chrome.

PHIL J. RITZENTHALER.

3. Beauty & Permanence of Finish Combined by Etching Process. A. H. ALLEN "*Steel*" Vol. **97,** Nov. 11, 1935: 32-35—Describes procedure at Crowe Nameplate Company, Chicago in etching nameplates and decorative metal panels. Sheets are first prepared with the desired finish which later will be high lights of etched plates. Standard photolithographing process is used for transferring designs on to cleaned sheets from zinc printing plates. Blanks with portion to remain unetched protected by a baked coating of resist power, are lowered on racks into etching solutions, air agitated. Solutions used are nitric acid for plain steel, ferric chloride for stainless steel brass and bronze; hydrofluoric and hydrochloric for aluminum; sodium dichromate and sulphuric acid for zinc. Depth of etch varies from .001 to .003". The etched sheets are washed and dried with sawdust. Correct finish is then applied to background to produce desired contrast with high lights. Resist is removed with naphtha, sheets are cleaned, inspected, lacquered and then subjected to necessary machining operation. Other methods used are embossing, surface finishing without relief and lithographing.

PHIL J. RITZENTHALER.

4. Wooden Pickle Tanks—PAUL BENNINGTON "*Steel*" Vol. **97** Dec. 2, 1935 pp. 30-34—Discusses principles of design and construction. Best lumber for this service is dense, heavy, pitchy, close grained, long leaf yellow pine. Cypress and Douglas fir are also used. Tanks should have bare compression joints with no slip tongues, white lead, or any other sealing compound in joints. Bolts or rods should be sufficient in number and of such an area at root of thread so that with the given yield strength of the metal, pressure produced will be greater than 25,000 - 40,000 lbs. per sq. in., depending on type of joints. Presents table giving theoretical number of rods required for all sizes of tanks for parallel timber joints. Monel metal and aluminum bronzes generally are favored for tie rods. Alloys high in copper are more susceptible to corrosion by concentration cell action than those high in nickel. Tightening

up of tank as it shrinks is facilitated by placing end timbers vertically so that they do not cross grain with bottom timbers and holding taps by a cleat. Ends of rectangular tanks should be mortised into sides and bottom. Densest and strongest timbers should be placed on edges where washers bear. Side and bottom bolts should be as near to each other as possible Long tanks exceeding 3 ft. in depth, should have sides reinforced against bowing in.

PHIL J. RITZENTHALER.

1. **Sand Blasting** — ROBERT E. KUNKLER, *Metallizer*, Vol. III—Oct. 1935 pp 6-7—Effectiveness of metal spraying depends largely on proper preparation of the surface to be sprayed. Sand blasting to clean and roughen the surface is the standard method of preparation. Tabulations are given to show the rate of flow of various abrasives through different nozzle openings and air flow secured at various pressures. The quantity of air used is based entirely upon the nozzle size and not upon the size of the sand blast machine.

2. **Descaling Heat-Treated Parts**—*Automobile Engineer*, Vol. **25,** Nov. 1935—pp. 413-14—An improved electro-chemical process (Bullard-Dunn) for removing scale from heat-treated parts or forgings is described. The work forms the cathode so that the scale is lifted from the surface by the hydrogen generated in the descaling solution. At the same time a thin adherent protective metal film is deposited on the clean base metal from which the scale has been removed. This protects the exposed parts as the descaling process is continued to remove scale from remote or recessed parts and has the additional advantage that the throwing power of the solution is increased, since the flow of current is reduced or cut off from projections near the anode. Advantages over other pickling methods with their attending chemical actions are pointed out and the practical application of the method is described.

3. **Anodic Oxidation of Al and its Alloys**—A. DUMAS, *Metaux*—Vol. 9, Oct. 1934, pp 550-552—Anodic oxidation processes are grouped according to the acid used as electrolyte; chromic, sulphuric or oxalic. The thickness of oxide layer varies linearly with the amount of electricity used. Elasticity of the film depends on bath temperature, concentration, length of treatment, voltage and the nature of the current. Films formed at low temperature and low voltage are very resistant. In practice the amount of current used varies according to the process: for chromic acid 2-4 kw. hrs/m^2; 0.7 to 2 kw. hr. for H2So4 and 10-20 kw. hr. for oxalic acid. This film will take any color if the sample is immersed in an organic color solution. Aluminum and its alloys used in hydroplanes are all anodically oxidized.

4. **Tube and Sheet Grinding**—*Mechanical World & Engineering Record.* Vol. **48**, Oct. 11, 1935, pp. 357,364—The special grinding devices necessary for tubes and sheets due to their lack of rigidity are considered. The grinding machines described are of American design.

5. **Machining Flat Surfaces by Disc Grinding**—*Machinery*—London, Vol. **47**, Oct. 31, 1935, pp. 129-133—A new deep corrugated or plane face, coarse grit, grinding disc is used. The deep corrugated disc, like a circular waffle, always presents a sharp surface. They are mounted horizontally or vertically or duplex to grind opposite faces simultaneously. Production figures and costs are discussed, the various types of machines and wheels shown and products

handled given in photos. Some of the discs are in one piece; the larger ones are built up with removable sections.

6. Electrolytic Deposits on Aluminum. G. ELSSNER—*Aluminum*, Vol. **17**, July 1935 pp. 376-78—Electroplating of aluminum consists in (1) cleaning in grease solvents (2) removal of all traces of grease (3) preparation of the surface to insure adherence of deposit (4) deposition proper (5) subsequent treatment. The several steps are fully discussed. Only trichlorethylene, benzene or petroleum can be used for degreasing A1 and washing should be done in dilute HNOZ with or without addition of HF particularly for copper containing A1 alloys. The surface should be roughened by pickling, preferably in dilute HCL or HF; sandblasting cannot be recommended. Alkaline pickling solutions are made up of sodium zincate with an excess of alkali and used at 30°-40°C. The electroplating bath used depends to some extent on the surface treatment, Ni and acid Cu plating solutions are preferred. A1 which was plated in a zincate solution can be Ni plated only in a citric Ni bath which must be stirred. Plating with Cd, brass, or chrome requires an intermediary Ni layer. Cast objects are generally more or less porous so that the electrolyte remains in the pores which may cause efflorescence. Subsequent treatment is especially recommended for such parts. Drying at 100°C and closing of the pores by immersion in hot oil or fat is recommended.

7. Materials Aid Electrochemistry in Plating—JOHN C. BOGLE, *Machine Design*, Vol **7**, July 1935, pp. 27-28—In discussing the large scale electroplating of parts, it is shown that by anodically charging the entire frame work of the barrel, the working parts of the barrel do not become plated. The anode potential of steel is several volts higher than that of the active anode material and all current is diverted through the latter.

"Progress in the Electrodeposition of Metals", by C. B. F. YOUND, Ph. D., *Metal Cleaning and Finishing*, February 1936—Within recent years several additions have been made to the list of metals that can be electrodeposited. Among these are rhenium, antimony, arsenic, gallium, indium, magnesium, manganese and aluminum. Rhenium offers distinct possibilities. The other metals have aroused little commercial interest. Familiar metals have benefited through constant research. Development of control methods have facilitated the deposition of alloys, as, for example, zinc and cadmium.

E. T. SHEEHAN

"Recent Developments in Electroplating"—by M. de KAY THOMPSON, *Metal Cleaning and Finishing*, February, 1936—A new formula for pink gold contains nickel, gold, palladium and copper. Rhodium is most satisfactorily deposited from an ammonium sulphate bath. A sulphate-oxalate strike bath has been developed for use on steel prior to plating in the conventional sulphate solution. Recent research indicates that tungsten deposits are actually iron-tungsten alloys. When the iron in the bath is exhausted, the deposition of tungsten stops. Lactic acid appears to be the best addition agent to alkaline stannate baths. Various alloys have been studied. Cadmium and zinc have been co-deposited from a sulphate solution. Magnesium and aluminum have been deposited from non-aqueous organic electrolytes. Rhenium is successfully deposited from a solution of potassium perrhenate containing sulphuric acid.

E. T. SHEEHAN

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTRO-PLATERS' SOCIETY

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch A. E. S. was held on Friday, April 3, 1936. Dinner was served for eighteen members, after which minutes of previous meeting were read and approved. Dr. Stout of Washington University, our Chief Adviser was there, and all of those members that were not there sure missed a real meeting.

The Doctor was asked to serve as Librarian in the absence of Ad. Barth.

After asking for questions, he spoke on Bright Nickel, all its good points and some of the bad points. Some samples were shown. Dr. Stout then took up Bright Zinc, as this seems to be the coming thing in Electroplating; the talk just fitted in. He told of some of the things that he found out in plating with Bright Zinc in regard to the thickness and the Bright Deposits. As it seems the main thing in this Solution is in keeping it clean. After some discussion Dr. Stout told of some work he has been doing on Tin Plating and also had some samples which looked very good.

After all was said and done everyone said it was one of the best meetings we have had in a long time thanks to Dr. Stout, so the next time you get notice of a meeting, stating that Dr. Stout will be with us, be sure you do not miss.

CHAS. T. MCGINLEY, *Sec.*

SPRINGFIELD BRANCH

Regular meeting of the Springfield Branch was held April 26, 1936 at the Indian Social Club with President Seidel in the chair.

There were eighteen members present.

The minutes of the previous meeting were read and approved.

The Secretary reported that the permanent charter had arrived and also read a letter from Supreme President Slattery congratulating the Springfield Branch.

The next business was election of officers for the coming year.

Mr. William Seidel was elected President; Mr. Walter Barrus, Vice-President, Mr. Henry Delarm, Secretary-Treasurer and Mr. F. J. Clark, Librarian.

The Board of Managers elected were Mr. T. J. Murray, Mr. C. Niles and Mr. W. J. R. Kennedy.

Mr. T. J. Murray, Mr. W. J. R. Kennedy and Mr. William Seidel were then elected delegates to the National Convention to be held in Cleveland.

Mr. W. Barrus, Mr. Ernest Sager and Mr. J. Mongeau were elected alternates.

The amendment to the Constitution proposed by the Baltimore-Washington Branch was read and discussed, after which the delegates were instructed to vote in favor of it at the National Convention.

Mr. Clark then introduced the speaker of the evening, Mr. A. H. Blake of the Blakesly Co., Chicago. His subject was vapor degreasing. He also brought equipment and demonstrated it by degreasing some samples submitted by various members. He was given a vote of thanks after which the meeting adjourned.

H. R. DELARM, *Sec.*

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FINISH
IS NO BETTER THAN
THE LACQUER THAT
PROTECTS IT—

The same care, thought and planning that goes into the manufacture of your product should be given to the selection of a proper coating—one formulated to meet your specific requirements.

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THE STANLEY
CHEMICAL COMPANY
EAST BERLIN, CONN.
A Subsidiary of The StanleyWorks
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NEW YORK BRANCH

There were two meetings of the Branch during April—Friday, April 3rd, the first meeting, was a business meeting during which several matters of Branch policy was discussed. At this meeting the question of New York Branch interesting itself in seeking the 1937 Convention of the National Society for New York was taken up for consideration. Through the earnest efforts of Mr. John E. Sterling, a long time member of the Branch and past supreme president of the A.E.S., ably seconded by Ralph Liguori, past president of N. Y. Branch, and several of the more active members, the proposition was enthusiastically and forcibly brought before the membership. After much discussion it was tentatively agreed that New York would bid for the 1937 Convention at the Cleveland meeting.

On Friday, April 24th, the Branch held an educational session at which Dr. Harold Work of the Aluminum Corp. of America staff gave an interesting lecture on "The Electrolytic and Color Finishing of Aluminum Products." Dr. Work explained in part the methods of procedure relative to the production of this line of work and displayed many samples of the product for the interest of the members. At the conclusion of his talk Dr. Work invited questions relative to his subject and answered many queries put by those present. After the discussion the Branch extended a rising vote of thanks to Dr. Work for his fine effort in presenting his subject.

Two applications of Joseph Lerner and David Schwartz were received seeking membership in this Branch.

F. J. MacStoker, *Sec.*

DETROIT BRANCH

A regular meeting of the American Electro-Platers' Society, Detroit Branch was held at Hotel Statler, on April 3, 1936 (Friday evening) at 8:00 P. M. with W. W. McCord, president, presiding.

There were present 75 persons, which is a very good attendance.

The minutes of the previous meeting were read and approved.

The following applications for membership were read and referred to the Board of Managers:

John Pearsall, 1136 Collingwood Ave., Detroit

Wm. A. Wischol, Douglas & Lomason Co., Detroit

Samuel Henry Douglas, c/o Robt. L. Reed Co., 2567 Parker Ave Detroit

Matt Koch, 1246 Benjamin Ave., Windsor, Ontario, Canada

George A. Meyers, Bruce Products Co., Detroit

The application of W. R. Shields was reported on favorably by the Board of Managers, and he was elected to Associate Membership.

It was decided that on account of the Cleveland Convention coming so early in June, we proceed this evening with the nomination of officers and that they be elected at our next meeting, which will be May 1st, and also installed at that meeting, and that the May first meeting will be the last meeting of the Branch to be held until the first Friday in September.

The following nominations were made:

For President, A. B. Wilson; for Vice-Presidents, Geo. Kutzen, A. Gorden Spencer; for Sec.-Treas, T. C. Eichstaedt; for Librarian, T. Kirby, G. Soderburg, W. W. McCord, Carl Huessner; for Board of Managers, W. W. McCord, Chas. Beaubien, Eric G. Sampson, Jr. and A. Gordon Spencer.

For delegates to the Convention: T. C. Eichstaedt, A. B. Wilson, A. Gordon Spencer, W. W. McCord, Geo. Kutzen, L. P. Brockway, Carl Huessner, Chas. Mascola.

Next on the program came the speaker of the evening: Mr. George Hogaboom. His talk was illustrated with slides and specimens of work to be examined. It was very educational and entertaining and very much worthwhile. His talk was on "Protective Coatings by Electro Deposition." Mr. Hogaboom was given a very hearty vote of thanks for his paper.

Mr. W. W. Phillips of the Research Fund read a report, which was very interesting. I will not go into figures here as they have been published in the REVIEW and the fund finances are coming along very lovely, nothing to be worried about at all.

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Offices and Agencies in Principal Cities

The meeting adjourned at 10:30 P. M.

T. C. EICHSTAEDT, *Sec.-Treas.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held Saturday, April 11, 1936 at the Atlantic Hotel.

President F. Herbst presiding and all other officers present.

Mr. S. J. Borta was elected to active membership, an application from Mr. F. E. Bless also one from Mr. F. P. Cisco read and committees appointed on same.

Mr. C. S. Tompkins made a very fine talk and report on the research and urged all the members to take this very interesting and necessary matter up with their firms.

Mr. H. A. Gilbertson chairman of the Smoker committee stated that all

plans were complete for our smoker to be held at the Auditorium Hotel on Saturday, May 23.

Mr. O. E. Servis stated that there would be a short but very interesting Educational program for our Smoker.

Mr. W. Bott reported that one of our oldest members Mr. J. J. Witte had recently lost his oldest son. Chicago Branch Officers and members wish to extend their deepest sympathy to Mr. Witte.

The librarian found the following questions in the question box.

No. 1. *Can silver be deposited from an acid solution?*

Answer. Yes, silver nitrate solutions have been used but cyanide solutions work best.

No. 2. *What is a good bright dip for stainless steel cups?*

Answer. Pickle in hot Muratic acid then bright dip in Sulphuric acid 2 parts nitric acid 1 part.

No. 3. *What causes Black lacquer to rub off or flake off of oxidized steel stampings?*

Answer. Too strong or too old an oxidize solution, or not the proper lacquer.

BALTIMORE-WASHINGTON BRANCH

We are enclosing eight (8) duplicate application blanks for membership. These men were duly accepted members of the Baltimore-Washington Branch at our last regular meeting on April 4.

We had an exceptionally good meeting. Dr. Wick who has spent quite some time in Europe was the speaker for the evening. His subject was:

"OBSERVATIONS OF ELECTRO-DEPOSITION IN EUROPE"

After the meeting closed refreshments were served, and everybody enjoyed a pleasant social hour. Twenty-seven (27) members present.

At our next meeting on May 9, we will hold our annual election of officers and make final arrangements for the coming convention.

IRVIN H. HAHN, *Sec.*

MILWAUKEE BRANCH

The Milwaukee Branch held its regular meeting Thursday, April 9th. Meeting called to order by our President, Robt. Steuernagel — there being a very good attendance. Mr. Dan Wittig, Chairman of our Annual Educational meeting and smoker, and his committee were discharged with a rising vote of thanks. The Annual meeting was one of the best Milwaukee has ever had.

Last summer at our Annual picnic some of the Chicago boys suggested that Milwaukee and Chicago get together for a joint picnic. Milwaukee voted in favor of this and now awaits the decision of the Chicago branch.

Nomination of officers for our next fiscal year was as follows: Mr. Dexter Rhodes, President; Mr. Henry Binder, Vice-President; Mr. Henry Bornitzke, Librarian; Mr. Roman C. Binder, Sec-Treas.; Board of Managers, Mr. Jack Seissman, Mr. Paul Krause and Mr. John Miszewski, Jr.

The speaker of the evening was Mr. Vincent Sheehan, son of our Supreme Vice-President, Pat Sheehan, who talked on, "The administration of a finishing department."

R. C. BINDER, *Sec.-Treas.*

WANTED to buy for spot cash a mailing list of firms doing oxidizing. Potential users of McKeon's "Liquid Sulphur" "The Oxidizing Agent of Today". — Sulphur Products Co., Inc., Greensburg, Pa.

BRIDGEPORT BRANCH

The April meeting of the Bridgeport Branch was held on April 3, 1936, at Franklin Club, New Haven. There were fifteen members present.

Final report of the Banquet committee was read and approved.

A communication from E. Steen Thompson regarding the coming convention was read and voted placed on file.

Joseph Wenick of Greist Mfg. Co., New Haven was elected to active membership.

Meyer Freed of The Seymour Mfg. Co. was elected to Associate membership.

The application of John Harper was read and turned over to the Board of Managers for approval.

It was announced that election of officers and delegates to the national convention would be held at the May meeting.

A motion was made and passed that the Bridgeport Branch submit an exhibit to be shown at the Cleveland Convention in competition with other Branch exhibits.

After the meeting refreshments were served. CHAS. H. COSTELLO, *Sec.*

BINGHAMTON-ELMIRA BRANCH

The Binghamton-Elmira Branch of the American Electro-Platers' Society held their monthly meeting at the Y.M.C.A., Binghamton, Monday, April 6. An excellent crowd turned out. After enjoying the dinner, our President, Mr. Fletcher called the meeting to order and a short business session was carried on. It was decided not to hold our Monthly Meeting during the month of June because of the Convention.

Mr. Jack Harnett, our Librarian introduced the speaker of the evening, Mr. E. S. Brown of the Norton Co., Worcester, Mass. Mr. Brown gave us a very interesting talk on Polishing, Cutting-down and Barrel Burring. Many members and visitors took advantage of the opportunity of asking Mr. Brown questions on their own particular troubles and received very helpful information from this Veteran finisher who has gone through the mill himself and knows all the answers.

The meeting adjourned with everyone feeling that they had gained a little more knowledge with which to combat their daily troubles.

LARRY MEYER, *Sec.*

WATERBURY BRANCH

Owing to the fact that the April meeting of Waterbury Branch fell on a holiday, the attendance at same was not as large as usual. Those present however, had an interesting session, several subjects being brought up for discussion which included bright zinc plating, chrome plating, the finishing of stainless steel and ball burnishing.

The committee on speakers announced that Mr. George Hogaboom would speak at the May meeting, which takes place, Friday, the 8th.

Communication from Supreme Secretary relative to the change in Convention dates was received, as were also the proposed amendments to the Constitution offered by the Baltimore-Washington Branch. As the amendments seemed to be of an important nature, it was deemed advisable that action on same be deferred to the next meeting.

Those present seemed to concur with the editorial in the REVIEW, that "our business sessions could be conducted more efficiently;" and also, "that the final business session should not be the last item on the program." A change in this arrangement would

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not necessitate the rushing through of important business without due consideration or the leaving of same over to the incoming executive board.

At this time it would seem as though Cleveland during the month of June should prove a great drawing card for the people of Connecticut and the other states. The Platers Convention, G.O.P. Convention and the Centennial Exposition should prove great drawing cards. Around here they tell us that the founder of Cleveland was Moses Cleveland, a Connecticut man and that the big city on Lake Erie was once known as "New Connecticut."

W. F. GUILFOILE, *Sec.*

ANDERSON BRANCH

Our regular monthly dinner meeting as held, April 14th, dinner being served to twenty members. Following dinner, President Castell, called upon Mr. C. D. Cleaver, founder and past president of Anderson Branch to address the meeting.

Mr. Cleaver spoke on "Management's responsibility for quality Electro-Deposits." Emphasis was given to the fact that service in the field largely depends upon platers meeting minimum deposit thickness specifications. Several questions were raised regarding the comparative corrosion-resistance values between the old type buffed nickel deposit and the new bright nickel which is not buffed. Following some discussion, the reflected opinions indicated that because of a probable more uniform thickness and a more dense crystalline structure, the bright nickel deposit should be at least as good from a protective value viewpoint as nickel deposits that were 'flowed' under color buffing.

Meeting adjourned at 9:00 P. M.

SPECIAL MEETING A. E. S.

A special dinner meeting was called Friday evening, April 24th, in order that Anderson Branch might take advantage of our opportunity to secure the services of one of the industry's most prominent metal cleaning authorities.

Dr. Robt. W. Mitchell, Technical Director of the Magnus Chemical Co. and author of the "Metal Cleaning Handbook," and numerous articles on metal cleaning, presented a most interesting discussion of metal cleaning problems and some of the more recent developments in this field. Different types of wetting agents such as sul-

NATIONAL ELECTROPLATERS ASSOCIATION

1913 New York City 1913 Reorganization to A.E.S.

A.E.S.

ANNUAL MEETINGS AND PRESIDING OFFICERS

1914	Chicago, Ill.	G. B. Hogaboom
1915	Dayton, O.	H. J. Hansjosten
1916	Cleveland, O.	Walter Barrows
1917	St. Louis, Mo.	H. H. Williams
1918	Detroit, Mich.	Walter J. Fraine
1919	Philadelphia, Pa.	Walter J. Fraine
1920	Rochester, N. Y.	O. E. Servis
1921	Indianapolis, Ind.	S. P. Gartland
1922	Cincinnati, O.	Philip Uhl
1923	Providence, R. I.	Walter J. Allen
1924	Milwaukee, Wis.	J. E. Sterling
1925	Montreal, Canada	F. J. Hanlon
1926	Newark, N. J.	E. J. Musick
1927	Toledo, Ohio	F. C. Mesle
1928	Toronto, Canada	John H. Feeley
1929	Detroit, Mich.	Horace Smith
1930	Washington, D. C.	Horace Smith
1931	Rochester, N. Y.	George Gehling
1932	Philadelphia, Pa.	Philip Sievering
1933	Chicago, Ill.	C. A. Van Dereau
1934	Detroit, Mich.	C. A. Van Dereau
1935	Bridgeport, Conn.	H. A. Gilbertson
1936	Cleveland, Ohio	T. F. Slattery

phonated oils, sulphonated alcohols and soaps were discussed and practical demonstrations made as to their effectiveness. Sometime was given to questions and discussion after which President Castell thanked our speaker on behalf of the Branch, for a most pleasant and profitable evening.

Meeting adjourned at 10:30 P. M.

J. W. MINTON, *Sec.*

LOS ANGELES BRANCH

Minutes of the Los Angeles Branch A.E.S. regular monthly meeting held March 11, 1936.

Minutes and financial report were read and accepted.

Bills for per capita tax and card party expense were read and ordered paid.

The application of Mr. Bessolo was held over until next meeting because of the absence of Mr. Rynkofs chairman of the Board of Managers.

The members instructed the secretary to send a wreath from the branch to the funeral of Mr. Rynkofs' mother-in-law.

The meeting was then turned over to the librarian. He read a very interesting paper on "Tin Plating from an Acid Solution" by one of our members, Mr. W. J. Blanch in Australia. Samples plated in the solution were shown and an interesting discussion followed.

The following questions were found in the box:

Q. *Is it advisable to use nickel-plated steel anodes in a combination cleaner and copper strike?*

A. Yes.

Q. *What is the reddish tint on nickel anoded?*

A. Impurities in the anodes. Higher grade anodes do not have this trouble.

EARL COFFIN, *Sec.-Treas.*

TOLEDO BRANCH

pays tribute to the work of

George B. Hogaboom

The Hanson-Van Winkle-Munning Company,
Matawan, New Jersey
Gentlemen:

We wish to take this opportunity to thank your company for the privilege accorded us of having had Mr. Geo. G. Hogaboom address our members and friends at the New Secor Hotel on April the 2nd.

In his talk "What is Under the Plate", Mr. Hogaboom far exceeded the expectations of those present — between eighty-five and one hundred. And we did expect considerable, because we were aware of Mr. Hogaboom's knowledge on this subject. From a standpoint of both numbers and educational value, this meeting

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had no parallel in the history of our organization.

Several requests for reinstatement, and a few new applications have been received in the past few days, and we have a feeling that the effects of this meeting will bring out renewed interest and activity in our branch which of late has been at a very low ebb.

We wish that every branch in the A.E.S. could hear Mr. Hogaboom give one of his talks, and your company certainly merits the sincere thanks of our national organization for making this possible; thanking you again, and hoping that in the near future we may again have Mr. Hogaboom as our guest speaker, we are:

Sincerely yours,
TOLEDO BRANCH, A.E.S.
WALTER W. WEIKER, *Sec.*

TORONTO BRANCH

Members and guests turned out in exceptionally large numbers to attend our April 27th meeting to hear a splendid talk by our esteemed President, Mr. John Acheson. His subject "The progress of electro-plating since Faraday's time" was handled in a masterly manner and practically every phase of electrodeposition of metals was given a reasonable portion of the one hour and a half which was required for the talk. Mr. Acheson illustrated his talk by means of expertly finished samples of various finishes, copper, brass, silver, gold, nickel, rhodium, cobalt, cadmium, chromium, black nickel and a pair of harness hames finished in silver by the close plating method. This was one of the most interesting evenings we have spent during the season and made a very fitting wind-up for the year. Questions relative to plating plaster molds and operating a cadmium plating barrel were discussed with much spirit and interest. Wax was declared preferable to shellac for coating plaster molds and sodium cyanide and a brightener were advised for a cadmium barrel solution when the deposit became very dull or dark colored. Large angle shaped pieces were said to be better adapted to still plating in cadmium. Owing to the unusual amount of business the discussion of the Amendments proposed by Baltimore-Washington Branch was not finished but will be given careful consideration at the May meeting and our delegate, Mr. Walter S. Barrows will be instructed how to vote on the question. At present the indications are that several Toronto members and others will attend the convention. Three applicants were elected to active membership, others have promised to have applications in for our May meeting. Among the old timers present were Harry Creswell, Wm. Sutherland, Martin Robinson, Alex Armstrong and Colin Turner. Two members reported loss of jobs through failure of firms to procure sufficient business to warrant continuous operations. Tom O'Keefe gave us a splendid talk on preparation of plaster molds for electroplating. Ernest Coles will devote the spring and summer seasons to cultivation of flowers and garden produce. Ernie is remarkably expert at that game. Our Membership Secretary will make his report for the year at the May meeting; he has carried on a determined search and repeated efforts to bring all the eligible platers of Ontario into the society. Failure to secure their applications is due to many reasons over which neither he nor the prospects have control. Nevertheless, we are not down-hearted. Some of the best platers of the province have enrolled and that is something to be thankful for. Now fellows from Ontario — let's go to the convention. H. W. GRAHAM, *Sec.-Treas.*

RELIANCE PORTABLE PLATING BARREL

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A complete unit which can be suspended in any plating tank at least 24 in. x 18 in. x 10 in. deep. Capacity of barrel one peck of light stampings or 30 lbs. of screw machine products.

Size of barrel 10 in. x 18 in. Weight 32 lbs. Barrel is made of materials which are acid and alkali resisting and non-absorbent. Can be used with all standard solutions except chromium; also with strong cleaners; and at temperatures up to 150 deg. F. Furnished to operate from A. C. circuit 110 or 220 volt, or from 6 volt D. C. plating circuit.

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DEALERS IN PRINCIPAL CITIES

PROPOSED AMENDMENTS TO THE CONSTITUTION of the AMERICAN ELECTRO-PLATERS' SOCIETY

The Baltimore-Washington Branch has given notice that it will sponsor a motion to amend our Constitution after giving consideration to the recommendation of the Auditing Committee to the Twenty-Third Annual Meeting, June 11, 1935. "That two Amendments to the Constitution be framed regarding the Editor's, and the Secretary-Treasurer's salary, in order to save more extra work by the Auditing Committee in the future, and have it settled once and for all.

Purpose—The purpose of the proposed amendments is to provide for the employment of a full-time Executive Secretary who shall perform the present duties of the secretary, treasurer and editor, and other duties pertaining to a headquarters office of the Society. Preliminary estimates indicate that the total expense involved, including traveling expenses, would not exceed $3000 per year. At present about $1000 is being expended for these purposes. It is believed that the remaining $2000 can be obtained from increases in (a) membership (b) advertising and (c) subscriptions to the Research Fund, that will result from the proposed reorganization of the work.

Amendments

(In the following amendments, the significant changes are underscored).

(1) Amend Article III, Section 1, to read:
"The officers of the Supreme Society shall be a President, a Retiring President, a First and Second Vice President, an *Executive Secretary*, and an Executive Board."

(2) Amend Article III, Section 2, to read:
"The Executive Board shall consist of all the *elected* officers of the Society."

(3) Amend Article IV, Section 4, and Section 5, to read:
(This is entirely revised)
"It shall be the duty of the Executive Secretary to perform the duties heretofore assigned to the Secretary-Treasurer and the Editor, and such other duties as may be assigned to him by the Executive Board."

He shall keep an accurate report of the proceedings of each meeting of the Supreme Society, and of the Executive Board. He shall take charge of all

funds of the Supreme Society, pay all bills properly presented to him for payment, with the approval of the President, and deposit the funds in such a manner as the Executive Board may direct. He shall receive all moneys paid by the Branch Societies, and give receipts therefore. He shall keep an itemized record of all receipts and expenditures, and shall have his accounts ready for auditing at each annual meeting, or at any time the Executive Board may deem advisable. He shall be in charge of the Bureaus of Information, Employment and Education. He shall take charge of and preserve all papers and documents pertaining to his office.

He shall preserve in good condition all papers sent to him by any member or by any Branch Society, and attend to the editing and publishing of such matter as the Society may direct. He shall take charge of all literature belonging to the Society. He shall have power to appoint members of the Editorial Staff. At the Annual Convention he shall give a report of his activities.

His salary shall be fixed by the Executive Board, subject to its approval by the Supreme Society in the annual budget submitted by the Executive Board. He shall furnish the bonds required by the Executive Board.

(4) Amend Article IV, Section 6, by changing in line 9, words, "Secretary-Treasurer" to "*Executive Secretary*", and by adding the following paragraph:

NEW

"The Executive Board shall submit to the Annual Meeting of the Supreme Society a budget of the estimated receipts and expenditures for the ensuing fiscal year. After this or an amended budget has been approved by the Supreme Society no expenditures for any items shall be increased by more than twenty (20) per cent. without the approval, by letter ballot of the Supreme Society. If at any time the receipts are less than those estimated, the Executive Board shall endeavor to decrease the expenditures accordingly."

(5) Amend Article V, Section 1, to read:
"All officers of the Society, *except the Executive Secretary*, shall be elected and their terms shall be for one year. *The Executive Secretary shall be appointed by the Executive Board, and shall continue to serve until his successor is appointed and qualified to serve by the Executive Board.*

(6) Amend Article IX, Section 1, and Section 5, by substituting "Executive Secretary" for "Supreme Secretary".

(7) Amend Article XI, Section 1, and Section 4, by substituting "Executive Secretary" for "Supreme Secretary", and Section 6, by substituting "Executive Secretary" for "Editor".

T. F. SLATTERY, *President*

Membership Report

To April 18, 1936

ELECTED

S. J. Borta, 2324 W. Walton St., Chicago, Ill.
Active, Chicago Branch

Paul J. Dean, 20 "T" St., N. E., Washington, D. C.
Associate Baltimore-Washington Branch

Gilbert Parater, 1205 "C" St., N. E., Washington, D. C.
Active Baltimore-Washington Branch

C. Arthur Vincent-Davies, E. I. DuPont de Nemours, R. & H. Chemical Div., Wilmington, Del.
Associate Baltimore-Washington Branch

Matthew J. Kraft, 511 Clay St., Baltimore, Md.
Active Baltimore-Washington Branch

Samuel R. Warnock, 258 Kentucky Ave., S. E. Washington, D. C.
Active Baltimore-Washington Branch

Harris M. Lyon, 2250 Minn Ave., S. E., Washington, D. C.
Active Baltimore-Washington Branch

Emory L. Plate, 4601 Leeds Ave., Baltimore, Md.
Active Baltimore-Washington Branch

Roland S. Gregg, 2208 Ken Oak Road, Baltimore, Md.
Associate Baltimore-Washington Branch

S. J. Borta, 2324 Walton St., Chicago, Ill.
Active Chicago Branch

W. R. Shields, 4310 Buckingham, Detroit, Mich.
Associate Detroit Branch

Edw. P. O'Connor, 1171 Treat Ave., San Francisco, Cal.
Active, San Francisco Branch

Joseph Grimley, 44 Shirley St., Toronto, Canada
Active, Toronto Branch

Christ Lombardo, 56 Fifth St., Rochester, N. Y.
Active, Rochester Branch

Joseph Wenick, Griest Mfg. Co., New Haven, Conn.
Active, Bridgeport Branch

Meyer L. Freed, Seymour Mfg. Co., Seymour, Conn.
Associate, Bridgeport Branch

Carroll C. Swift, 97 Slade St., Belmont, Mass.
Active, Boston Branch

James W. Shaw, Jr., 10 Pearl St., Taunton, Mass.
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Robert Port, 46 Pearl St., Cambridge, Mass.
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Ernest Perkins, 1613 West 9th, Anderson, Ind.
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Ralph D. Walton, 1527 Kewalo St., Honolulu, Hawaii Terr.
Active, San Francisco Branch

Rudolph C. Marshall, 316 Shrewsbury St., Worcester, Mass.
Active, Springfield Branch

APPLICATIONS

F. E. Bless, 10 S. 58th Ave., W. Duluth, Minn.
Active, Duluth Branch

F. P. Cisco, 2649 N. Kildare Ave., Chicago, Ill.
Active, Chicago Branch

John Pearsall, 1136 Collingwood Ave., Detroit, Mich.
Detroit Branch

Wm. A. Wischol, Douglas & Lomason Co., Detroit, Mich.
Detroit Branch

Samuel H. Douglas, c/o Robt. L. Reed Co., 2567 Parker Ave.
Detroit, Mich. Detroit Branch

Matt Koch, 1246 Benjamin Ave., Windsor, Ont. Canada
Detroit Branch

George A. Meyers, Bruce Products Co., Detroit, Mich.
Detroit Branch

Richard R. Roscoe, 56 Freeman St., Wollaston, Mass.
Active, Boston Branch

Elton V. Buckley, 10 E. Broadway, Taunton, Mass.
Active, Boston Branch

John D. MacLean, Read & Barton Corp., Taunton, Mass.
Associate, Boston Branch

George H. Loeser, 45 Wessmur Rd., Malden, Mass.
Associate Boston Branch

Francis W. Bliss, Evans Case Co., N. Attleboro, Mass.
Active, Boston Branch

George W. Pickering, Back River, Hingham, Mass.
Active, Boston Branch

Harold M. Brigham, 6 Orris St., Auburndale, Mass.
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Colgate Gilbert, Walpole, N. H. Associate, Boston Branch
Arthur M. Collins, 39 Woburn St., Lexington, Mass. Associate, Boston Branch
William F. Burke, 41 Percival St., Dorchester, Mass. Active, Boston Branch
Daniel P. Mitchell, 158 Chelsea St., Charlestown, Mass. Active, Boston Brauch
Francis J. Brennan, 24 Warwick Rd., Watertown, Mass. Active, Boston Branch
Richard C. Ashendon, 160 Portland St., Boston, Mass. Active, Boston Branch

RE-INSTATED

Wm. J. Peters, 4 Brainard Ave., Middletown, Conn. Bridgeport Branch

TRANSFERRED

I. D. Niles from Bridgeport to Hartford
Ray Soper from Rochester to Binghamton-Elmira

SUSPENDED

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M. Carr, 5108 West 29th Place, Chicago, Ill. Chicago Branch
J. J. Gullis, 4216 Shenandoak, St. Louis, Mo. Chicago Branch
J. Mueller, 620 6th Ave., Bethlehem, Pa. Philadelphia Branch
Druery Harper, National Casket Co., Rochester, N. Y.
Ralph Hutchings, 33 Fountain St., Rochester, N. Y.
B. G. McManus, 66 Minerva St., Tonowanda, N. Y.
Wm. G. Price, Standard Brass Co., Utica, N. Y.
Harry Puffer, 56 Catalpa Rd., Rochester, N. Y.
Ed. F. Moulder, 11½ Susquehanna St., Binghamton, N. Y.
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R. E. Pettit, Aluminum Colors Inc., Indianapolis, Ind.
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Mr. James W. Higgins, Packard Motor Car Co., Detroit, Mich., previously reported as an ASSOCIATE member should have read ACTIVE member.